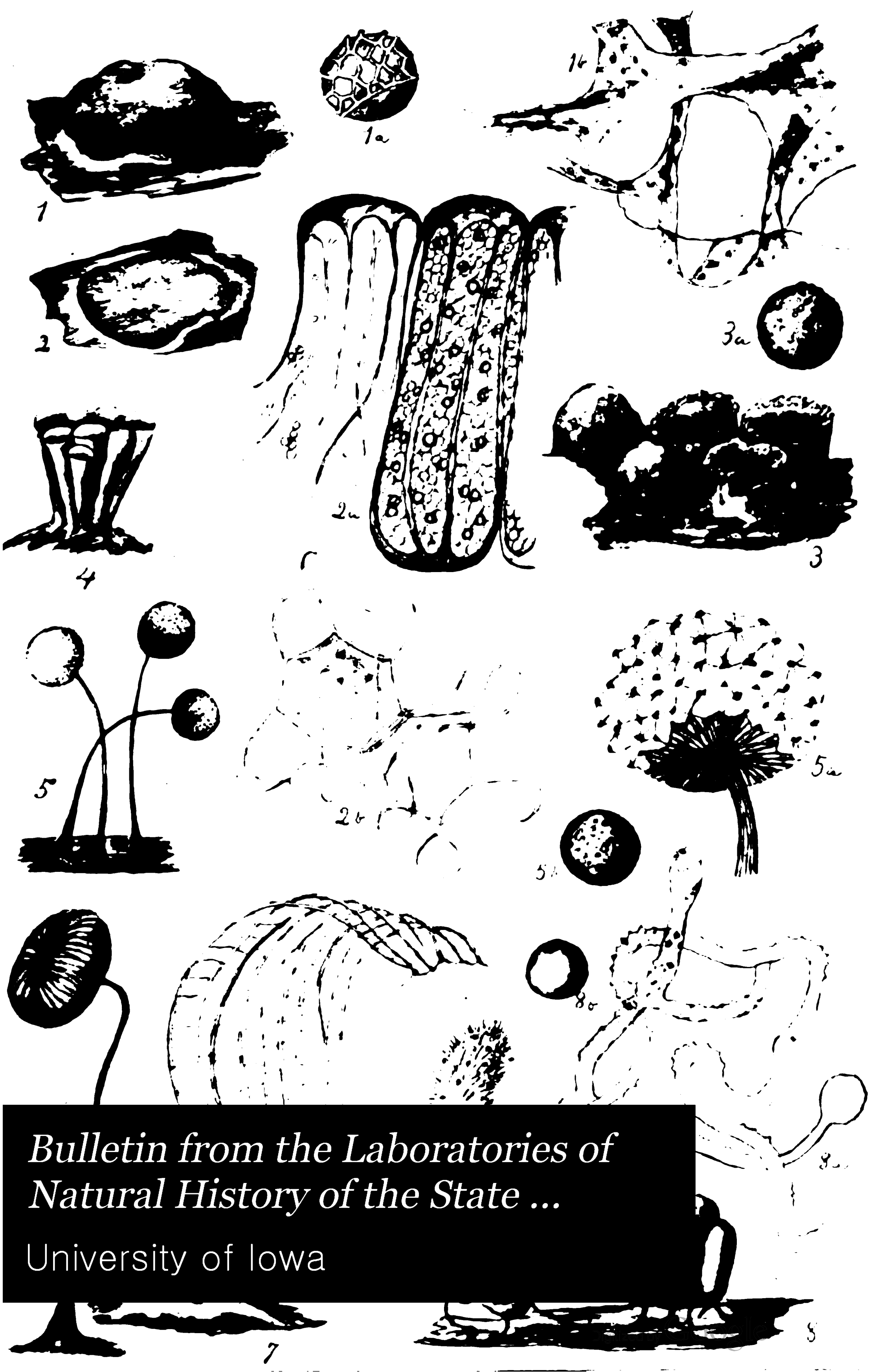

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University of Iowa

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FROM THE

LABORATORIES OF NATURAL HISTORY

OF THE

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By E. Brendel, M. D., and H. F. Wickham.
—*Concluded.*

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IOWA CITY, IOWA.
NOVEMBER, 1890.

Secretary Wm. J. Haddock:

We have pleasure in submitting herewith No. 1 of Vol. II., Bulletin from the Laboratories of Natural History.

THE EDITORS.

PREFATORY NOTE.

In the present Bulletin the papers on the Pselaphidæ and on the Lœss fossils are brought to completion. The second number of this volume may be expected in June, 1891.

Editors,
S. Calvin.
T. H. McBride.
C. C. Nutting.
B. Shimek.
H. F. Wickham.

State University of Iowa, Nov. 1st, 1890.

THE PSELAPHIDÆ OF NORTH AMERICA.

A MONOGRAPH BY

EMIL BRENDEL, M. D., AND H. F. WICKHAM.

[CONTINUED FROM PAGE 304 OF VOL. I.[1]]

EUPSENIUS, *Leconte*.

Antennæ clavate, the last joint very large, ninth and tenth lenticular, transverse; last joint of the maxillary palpi large, ovate; mentum narrow at the base; abdomen narrowly margined; posterior coxæ distant; tarsi with a single claw.

E. GLABER, *Lec.* Yellow, very smooth, without pubescence or punctures. Length, 1.0 mm.

Head bifoveate in a line between the eyes, wider than long; eyes moderately prominent. *Antennæ* with the first two joints larger, cylindrical, one-third longer than wide; joints three to seven equal, small, transverse; eighth twice as wide as long; eighth to tenth equal in length, rapidly increasing in width; the tenth four times wider than long; eleventh ovate, wider in the middle than the tenth and one-half longer. *Prothorax* slightly wider than the head, widest near the middle, the neck half as wide as the base, sides evenly rounded. Base angulate in the middle. Near the base is a median puncture, and on each side a large fovea connected with the middle one by an arcuate impressed line. *Elytra* as wide across the shoulders as the prothorax, one-half wider before the tip, sutural line slightly impressed, the base bifoveate, no discal lines. *Abdomen* short, the first dorsal segment as long as the third part of its width, without carinæ. Legs strong, the

1 For some verbal corrections and emendations of the former part of this work, see concluding page of the present section.

thighs clavate. The form of the whole body resembles that of *Decarthron longulum.*

Habitat. Louisiana, South Carolina.

E. RUFUS, *Lec.* Larger than *E. glaber*, differing in the form of the prothorax, which is described as less narrow behind and less sinuate at the sides near the base. Length, 1.25 mm. Alabama. Unknown to us.

PSELAPTUS, *Leconte.*

Head broadly excavated in front obtusely elevated each side above the distant antennal foveæ, front not retuse, convex, (produced). *Antennæ* eleven jointed, first and second joints a little stouter and longer, cylindrical; third to eighth shorter; ninth and tenth a little broader and slightly longer; eleventh pointed, oval, one-half longer than wide, and double the width of the tenth, outer part pubescent, with long hairs. *Maxillary palpi* as in Bryaxis, second joint long, clavate, third rounded, fourth elongate oval, acute, with a terminal seta. *Prothorax* very convex, campanulate, feebly transversely impressed near the base, without foveæ. *Elytra* convex, wider behind, without striæ or punctures. *Abdomen* with dorsal segments convex, finely margined, the first longer, with two short parallel carinæ not very widely separated, intermediate ventral segments short.

P. BELFRAGEI, *Lec.* Rufous, pubescence fine, sericeous; head broadly impressed in front, prothorax without foveæ. Elytra impunctate without striæ. First dorsal segment with two parallel lines. Posterior tibiæ long, slightly curved. The frontal impression is less deep at the middle than at the sides. Length, 1.0 mm.

Habitat. Texas.

VERTICINOTUS, *Brendel.*

Elongate, polished, thinly pubescent, prothorax subglobose, without lateral foveæ, elytra without basal foveæ, abdomen not broadly margined, with a linear transverse bar at the

base, half as long as the width of the segment. Sexual differences confined to the structure of the vertex, the antennæ, and the last ventral segment. Palpi with the third joint globular, fourth oblong ovate, yellow.

V. CORNUTUS, *Brendel.* Dark yellow, faintly punctulate, thinly pubescent with recumbent hair.

Head square, corners rounded, eyes with coarse facets. *Prothorax* subglobose. *Elytra* slightly flattened at the base, without basal punctures, the discal lines indicated by very short impressions, the sutural entire, straight. First abdominal segment one-fourth as long as wide, with a transverse linear bar at the base. Legs long, simple. ♂ *head,* occiput elevated, produced into two horizontal horns which are separated by a deep emargination, and overhang the surface of the vertex. The plane of the vertex is uneven, pubescent, with six punctures arranged in a circle; in the frontal angles, posterior to the slightly elevated antennal tubercles are two small spinulæ. *Antennæ* ten-jointed, first joint sub-cylindrical, half as long as the frontal margin; second similar, slightly smaller; third short, rounded, half as long as the second; fourth as long and thick as the first; fifth, sixth, and seventh, obconical, shorter, as thick as the third; eighth and ninth obconical, rounded. *Prothorax* as long and wide as the head, eyes included, and with a small puncture at the base. Last ventral segment with a deep circular impression. ♀ *head* slightly convex, eyes less prominent, vertex with two small punctures between the eyes, mutually three times as distant as either from the eye, and two smaller punctures near the antennal tubercles, a faint line connecting the four punctures. Frontal margin straight. *Antennæ* eleven jointed, first joint half as long as the frontal margin, obconical; second as wide as the first and half as long, obconical; third to eighth small, nearly globular; ninth and tenth gradually larger, trapezoidal; eleventh as long as the three preceding joints, and twice as wide as the tenth, oblong ovate; the fourth joint of the ♂ shows a transverse line indicating ankylosis of two joints.

The ♂ of this insect was formerly described by Dr. Brendel under the name *Decarthron cornutum*, and the ♀ as *Bryaxis inornata*. Afterwards finding them in large numbers with ants, he recognized them as sexes of one species.

Plate IX, Fig. 74, ♂; 75 ♀. Habitat. Iowa.

A second species of this genus was discovered by Mr. Schwarz, in Florida, and is thus far unknown to me. It is said to differ chiefly in the ankylosed antennal joints.

ARTHMIUS, *Leconte*.

Head quadrate, differently sculptured in the sexes. Antennæ regular and straight in the ♀, irregular in the ♂. Prothorax globose. Elytra much wider than long; abdomen short. The line of junction of the ventral and abdominal segments is straight, not serrate as in Batrisus; first segment one-third as long as wide, with four basal impressions, not convex longitudinally but very much so laterally, margin broad but not retuse. Fourth segment longer than its neighbors, first ventral very long. Legs slender, the anterior in the ♂ dilated and armed with a strong tooth near the middle.

A. GLOBICOLLIS. Deep yellow. Length, 1.7 mm.

Head, sides without the eyes parallel, occiput elevated, vertex convex, two small foveæ between the eyes, and two more behind the frontal tubercles. These tubercles are oblique and prominent, the frontal margin is transverse and emarginate in the middle. *Antennæ* with every joint of a different form and presenting a different appearance according to point from which it is seen. First and second joint cylindrical or obconical; third small, obconical, geniculate with the second; fourth undefinable; fifth large, semi-spherical; sixth small and globular; seventh subglobular, truncate, very large; eighth transverse, acute-ovate; ninth small, globular; tenth obovate; eleventh large, acutely ovate. *Prothorax* globular, with a straight flat transverse sulcus near the base, and at the base is a linear slightly elevated margin. *Elytra* twice as wide as

the head, including the eyes, very convex both ways, widest in the middle; sides strongly and evenly arcuate, shoulders not prominent. Disk narrowly elevated at the base, with three very small punctures on each elytron, sutural interval punctured, discal lines wanting. *Abdomen* with the last segment rounded at tip, last ventral with a deep transverse triangular cavity, slightly elevated in the middle at the bottom. Anterior tibiæ of ♂ gradually dilated from the knee to the anterior third and emarginate above from this point to the end, leaving a strong sharp tooth. Tarsi with the second and third joints equal in length, intermediate tibiæ with a terminal spine, posterior tibiæ arcuate. ♀ with head evenly convex posteriorly, somewhat roof-shaped anteriorly, the highest part rounded, the foveæ as in the ♂, the antennal tubercles nearly obsolete, the frontal margin triangularly produced from the margin to the middle. Elytra very convex longitudinally, shoulders less prominent and the disk much shorter than in the ♂; the first abdominal segment is slightly longer than in the ♂, the last aculeate, the last ventral semicircular at the base. The genital slit is straight at the sides, angulate at the middle, and in the middle of the area is a large flat-bottomed, triangular depression, leaving large, oval, convex, oblique elevations at the sides. Antennæ and legs simple and straight.

Plate IX, Fig. 76 ♀; 77 ♀, a. b. c.

For a knowledge of the ♀ I am indebted to Mr. Henry Ulke, who found them in considerable numbers near Washington. It seems to be confined to the Atlantic States.

BATRISUS, *Aubé*.

Form of the body circulo-cylindroid, narrow, elongate, abdominal margins not parallel to each other, the outer edge rounded not reflexed; the inner one oblique, causing the border of each elytron to appear triangular; the base of the dorsum is trifoveate, the elytra very convex, the discal lines never reaching beyond the middle. Prothorax with two or

three longitudinal grooves and a transverse binarcuate groove near the base connecting the three foveæ; the head is longitudinally oblong; the eyes small, smaller in the ♀; the vertex elevated above the level of the eyes, and an arcuate groove connects two occipital foveæ on the disk. The antennæ are inserted on the sides beneath lateral tumefactions of the frontal margin; the clypeus is variously sculptured; the labrum transverse; the maxillary palpi have the first joint small, cylindrical; the second long arcuate-clavate; the third small, globular; the last fusiform, more convex externally. Antennæ with the three terminal joints always enlarged; the legs long, with clavate thighs and slender tarsi which bear two unequal claws; the trochanters are commonly long, obliquely jointed to the thighs; the anterior coxæ are conical and contiguous, the posterior pair transverse.

TABLE OF SPECIES.

I. Posterior tibiæ without a terminal process; intermediate basal elytral fovea obsolete; occipital fovea nude.

1^3 Vertex not carinate in the middle, occiput tumefied, posteriorly overlapping the neck; ♂ intermediate thighs with a curved spine near the trochanters. Length 2.66 mm. Georgia. - - - - - *ionæ*.

1^2 Vertex with three convergent carinæ on the occiput; ♂ anterior tibiæ with a strong recurved spine near the middle, the intermediate femora notched above.

2^2 Occiput tumefied; ♂ posterior tarsi with the second joint dilated. Length 2.4 mm. Pennsylvania. - - - - - - *armiger*.

2^1 Occiput not tumefied, ♂ posterior tarsi simple.

Elytra punctulate, sides of prothorax abruptly sinuate behind; ninth and tenth antennal joints sub-equal, the eleventh wider than the tenth, ovate. Length 2.4 mm. Virginia. *ferox*.

1^1 Vertex with one occipital carina (doubtful) - . - - *confinis*.

II. Posterior tibiæ with a long terminal process, base of the elytra trifoveate.

1^3 Head prognathous, front not separated from the clypeus by an interantennal excavation in either sex. ♂ last antennal joint with an erect basal tooth.

2^2 Prothorax without discal crests; ♀ last segment pointed, vertical fovea nude. (Pacific coast species).

3^3 Shoulders hanging, obsolete, intermediate elytral basal fovea confluent with the internal one.

Vertex with a central impression, occiput with a rounded tubercle; prothorax with the median sulcus merely indicated near the median fovea. Length 1.9 mm. British Columbia. *albionicus.*

Vertex not impressed in the center, prothoracic median sulcus nearly entire. Length 1.9 mm. Middle California. *occiduus.*

3^2 Shoulders moderately prominent, rounded; ♂ last ventral with a large crater shaped fovea.

Black, legs and antennæ brown, occiput carinate; prothorax without a trace of median sulcus, elytral basal foveæ separate, conspicuous. Length 2.2 mm. Middle California. *monticola.*

Rust-red or piceous-red, elytra brighter, occiput carinate, prothorax with an anteriorly abbreviated sulcus; intermediate elytral basal foveæ nearly obsolete. ♂ with the fovea on the last ventral, large, crater shaped. Length 2.2 mm. Washington, Oregon, California, Vancouver Island. - *zephyrinus.*

3^1 Shoulders angular, armed with a minute, blunt tubercle; elytra with shallow, irregular, scar-like impressions; elytral basal foveæ separate, conspicuous. Length 1.8 mm. Middle California. - *cicatricosus.*

2^1 Prothorax with discal crests. ♀ last abdominal segment rounded. (Eastern species.)

Elytra strongly punctate, shoulders acutely angulate, ♂ last antennal joint toothed at the base; occipital foveæ nude. Length 1.0 mm. Pennsylvania, Illinois. - - - *schaumii.*

1^1 Frontal margin in the ♂ separated from the clypeus by a sulcus or excavation; in the ♀ continuous with the clypeus. (Atlantic slope.)

4^2 Frontal margin produced (♂) beyond the inter-antennal line.

5^4 Vertex slightly scabrous, vaulted and carinate; ♂ last antennal joint long, with an erect tooth; elytra punctate, shoulders not armed; vertical foveæ nude. Length 1.5 mm. Pennsylvania, Illinois. *riparius.*

5^3 Vertex coarsely scabrous, not vaulted, occiput carinate, circumambient sulcus obsolete, prothorax trisulcate; ♂ last antennal joint without a tooth.

6^2 Frontal margin (♂) notched in the middle, overhanging the clypeus; occiput carinate, occipital foveæ nude; shoulders angulate; head orthognathous. Length 2.2 mm. Pennsylvania, Illinois. *scabriceps.*

6^1 Head very flat, vertex slightly carinate, frontal margin triangular, declining to the clypeus and but slightly separated from it by a linear sulcus.

Prothorax with conspicuous discal crests and deep grooves, giving the disk the appearance of having five lines; occipital foveæ pubescent. Length 2.2 mm. Pennsylvania, Iowa. *lineaticollis.*

Prothorax without discal crests and median sulcus; vertex smoother in the middle. Virginia, Pennsylvania. *bistriatus.*

5^2 Vertex smooth, not carinate, front, behind the very retuse (♂) margin, deeply excavated; ♀ front declivous, not retuse; occipital foveæ pubescent, antennæ alike in the sexes.

Vertex, sulcus deep; prothorax without crests or spines; shoulders high, prominent, rounded. Totally impunctate, elytral basal foveæ two, the intermediate wanting. Length 2.2 mm. Illinois. - - - - - - - - - - - *frontalis.*

Vertex finely scabrous outside of the shallow circumambient sulcus; prothorax with four basal spines. Length 1.9 mm. Michigan, Iowa. - - - - - - - *simplex.*

5^1 Vertex high, roof-shaped, smooth, carinate throughout, foveæ nude, border broad, flat, very densely punctured; tenth antennal joint (♂) globose, larger than the last, shoulders spinous. Length 1.7 mm. Pennsylvania, Illinois, Iowa. - - - - - - - *globosus.*

4^1 Frontal margin not produced beyond the inter-antennal line, perpendicularly declivous above the sub-frontal excavation; tenth antennal joint (♂) very large.

7^2 Occipital foveæ nude, shoulders blunt, rounded, head orthognathous.

Reddish-brown, median prothoracic sulcus nearly entire; ♂ tenth antennal joint large, globose, with a small perforate fovea at the base. Length 2.1 mm. Virginia. - - *virginiæ.*

Black, antennæ and legs red, median sulcus entire, obsolete. ♂ tenth antennal joint large, globose, foveate beneath. Length 1.6 mm. Virginia. (*B. luculentus, Casey.*) - *spretus.*

Var. a.; median sulcus of the pronotum indicated; fovea of the tenth antennal joint very large - - - - *foveicornis.*

Var. b.; median sulcus short, more distinctly visible; tenth antennal joint very little larger than the ninth; last joint larger than usual. - - - - - - - - *punctifrons.*

7^1 Occipital foveæ pubescent, shoulders spinous.

Reddish-brown or black, with red elytra, antennæ and legs; vertex feebly carinate behind; ♂ antennæ with the basal joint bluntly toothed below, the tenth large, globose, with a small perforate puncture at the base below. Length 2.1 mm. Virginia, Iowa. - - - - - - - - - - *denticornis.*

Black, with reddish antennæ and legs; vertex with a fine, entire carina; ♂ antennæ with the basal joint spinous, triangular; third joint in both sexes longer and stouter than the second or fourth; tenth obconico-globular, large, not perforate. Length 2.0 mm. Long Island. (*B. spinifer* Brend. preoccupied.) *triangulifer.*

Black, with reddish antennæ and legs; occiput carinate; ♂ basal joint not modified; the third longer than the second or fourth, very much tumefied on one side; tenth joint large, globular, not perforate beneath. Length 2.0 mm. Georgia. *nigricans.*

Black, with reddish antennæ and legs; occiput carinate, vertex with a central transverse puncture; basal antennal joints in both sexes subequally decreasing in size; tenth long, globular, not perforate beneath. Length 2.0 mm. New York to Illinois. - - - - - - - - - *cephalotes.*

I.

Posterior tibia without a terminal spur. Frontal margin concave.

B. IONÆ, *Lec.* Reddish, polished, punctulate, pubescence thin scattered, recumbent. Length, 2.66 mm. Plate X., Fig. 79.

The *head* is longer than broad, occiput tumid, overlapping the neck; vertex declining from the occiput to the frontal margin and separated from the lateral and frontal margins by a slightly impressed circumambient sulcus. Eyes not prominent. The last palpal joint is three times longer than thick. *Prothorax* bell-shaped, widest in the middle, but little narrower at the base, with three longitudinal sulci of which the middle one is nearly entire and ends near the base in a small fovea. Between this fovea and each side of the median sulcus is a small, acute tubercle; the sides of the prothorax outside of the lateral sulci are depressed, and the space between the lateral and median sulci is smooth, not carinate. *Elytra* punctulate, pubescent, with low rounded shoulders; dorsal lines abbreviated before the middle, more deeply impressed at the base; sutural interval impressed. *Abdomen* very convex, slightly depressed at the base, punctured, pubescent. *Antennæ* not half as long as the body; joints first to eighth grad-

ually shortened and thinner; the ninth is as thick as the second, somewhat transverse; the tenth large, globular; the last oblong-ovate, much thicker in the ♂, and with a small tooth inside. Legs long, the intermediate femora in the ♂ provided with an acute curved spine below, near the trochanter. In the ♀ the last two joints of the antennæ are not so strong, the last without a tooth, and the legs are unarmed.

Habitat. Georgia.

B. ARMIGER, *Leconte*. Reddish brown, thinly pubescent. Length, 2.4 mm.

Head, eyes included, about as wide as long, quadrate; tempora acutely angled with the base; frontal tubercles obliquely oblong, rounded, the space between them strongly concave; occiput elevated, slightly produced over the neck, tricristate; the carinæ convergent to the middle; vertex broadly elevated, obsoletely scabrous; the circumambient sulcus broad, not deep, lost in the frontal concavity; foveæ rather large and shallow, pubescent. Eyes moderately large. *Antennæ* half the entire length of the body; first joint oblong obconical; the second slightly longer and narrower than the first; the last slightly wider, and as long as the five preceding together, (♂) truncate at the base, slightly tumid on the inner side; apex obliquely pointed. *Prothorax* as wide as long, widest before the middle, of the same width as the head including the eyes, and minutely dentate before the middle. The longitudinal grooves are very deep and nearly entire; basal tubercles acute; carinæ with three curved spines. *Elytra* impunctate, slightly wider than long; shoulders not spinous, rounded; discal striæ abbreviated at the middle, base trifoveate. *Abdomen* simple, the marginal triangle rather elongate, sides nearly parallel. Legs long, thighs clavate, tibiæ angulate. ♂, anterior tibiæ in front twisted, dilated about the middle into a large acute spine, twisted near the base, with a minute spine; intermediate thighs emarginate near the distal end. ♀, legs simple.

Habitat. Allegheny mountains. Pennsylvania.

B. FEROX, *Lec.* Reddish brown, rather densely pubescent, punctulate. Length, 2.4 mm. Plate X., Fig. 78.

Head transversely quadrate; posterior angles broadly arcuate, convergent; base elevated in an equilateral triangle limited by two anteriorly convergent carinæ, and with a third carina in the middle; foveæ small, in a line through the posterior third, laterally anterior to the elevated triangle; the vertex is declivous, anteriorly smooth, polished, the excavation limited by the nearly straight frontal margin. The sulcus originating in the occipital fovea is faint; the lateral margin is punctured; the frontal tubercles acute, dentiform, roofing the antennal cavity. The middle of the frontal margin is minutely carinate longitudinally. Eyes of the ♂ moderately large, not prominent, rounded. *Antennæ* half the length of the body; first joint cylindrical, emarginate above for the articulation of the second joint which is slightly narrower, oblong-obconical; joints three to nine gradually cylindrical, then quadrate, rounded, and slightly decreasing in width; tenth larger, globose in the ♂, obconical in the ♀; the last joint is as long as the two preceding, thicker, oblique, truncate, rounded at the base. *Palpi* dark brown, the last joint cylindrico-fusiform, lighter at the tip which is bent inward, and as long as the first antennal joint. *Prothorax* widest at the anterior third, where the width equals that of the head; sides strongly arcuate, somewhat sinuate behind the middle; base two-thirds of the greatest width; neck half as wide as the base. The length is slightly less than the width; the disk very convex; median sulcus fine, obsolete in the anterior fourth; lateral carinæ spinous, basal foveæ deep, nude, lateral ones irregular. The lateral sulci are slightly impressed, parallel to the sides, basal tubercles acute. *Elytra* convex, one-sixth wider across the shoulders than the thorax; sides very divergent; the greatest width is across the tips, where it is nearly one-half greater than at the shoulders. The length of the suture in the female is slightly greater than the width at the shoulders; in the male it is still

longer. The sides in the female are nearly straight, arcuate near the tip; in the male more evenly arcuate from the shoulders. Disk regularly punctulate, shoulders spinous, discal lines abbreviated in the anterior third. *Abdomen* longer than the elytra, the basal segment three times as wide as long and as wide behind as the elytra; basal carinæ very short, one-fifth of the segmental width apart; the fourth segment is longer than its neighbors, the ventrals sub-equal, the first longer. Legs long, tibiæ flat and angular inside, gradually stronger towards the distal end, and more densely pubescent. ♂, intermediate thighs emarginate above near the tip, anterior tibiæ twisted near the knee joint and with a very small spine, dilated and compressed in the middle. The upper half of the dilatation is emarginate, so as to form a large, strong, blunt spine; the distal end is again twisted. ♀, thighs simple, the eyes very small, situated far down on the sides of the head near the antennal foveæ, not rounded, rather irregular, with a spinous attachment posteriorly, which is in some specimens very small, in others quite conspicuous. Varies in the sculpture of the head and in the interval between the prothoracic carinæ being sometimes less smooth.

Habitat. Northern States east of the Mississippi.

B. MONSTROSUS, *Lec.* This species differs from *B. ferox*, according to the description, by the antenna having the last joint longer; from *B. armiger* it differs in the broader and shorter tooth of the anterior tibiæ. The description is not sufficient for a diagnosis, even if it be not a variety of *ferox*.

Unknown to us.

B. CONFINIS, *Lec.* The brief description is as follows:—Rufus, capite lævi, vertice elevato, 1-cristato, sulco circumcincto; thorace obsolete lineato, antennis gracilibus, articulo ultimo ovato. Thoracis spinis sub-basalibus, minoribus differt.

Unknown to us.

II.

Posterior tibiæ with a long terminal process, base of the elytra trifoveate.

B ZEPHYRINUS, *Casey*. Red, elytra brighter, or piceous with dark red head and prothorax and red elytra; legs, antennæ and palpi, yellowish brown, highly polished, pubescence coarse. Length, 2 mm. Plate X., Fig. 82. Plate XII., Fig. 141.

Head as wide as long, eyes prominent, neck slender, feebly carinate; occiput feebly carinate on a line passing through the middle of the eyes; two small, nude, oblong foveæ, mutually twice as distant as either from the eyes, are connected by an arcuate sulcus. The frontal margin is depressed between the coarsely punctured supra-antennal tuberculations and continuous with the simple clypeus; the vertex inside of the circumambient sulcus impunctate and bears a faint punctiform impression in the center at the end of the occipital carina. *Antennæ* longer than the head and prothorax; first joint longer than wide; second smaller; second to eighth obconical; eighth slightly transverse; ninth and tenth gradually wider, the latter (♂) obliquely truncate at the tip; eleventh larger, rounded at the base, conical at the tip, obliquely pointed, and with an erect cylindrical tooth at the base. *Prothorax* widest before the middle, as wide as long, sides arcuate, sinuate behind, converging to the base, which is three-fourths as wide as the disk and one-fourth wider than the neck; disk convex, median basal foveæ deep, rounded; median sulcus feeble, sometimes reaching to one-third the length from the neck, but occasionally hardly perceptible; on each side of the median fovea is a pointed, leaf shaped elevation, limited anteriorly by the arcuate, transverse, sulcus connecting the median with the lateral foveæ. In the center of these leaf shaped elevations and near the base each side is a deep puncture; the lateral longitudinal grooves are arcuate outwardly. *Elytra* in some very feebly and sparsely punctulate, in others smooth, trifoveate at the base; sutural lines parallel at the base; the interval

punctured; shoulders prominent, not acute; discal lines short, indefinite. *Abdomen* as wide as the elytra; the first segment three times wider than long; the basal carinæ nearer to each other than to the margin, variable in length, but always short. Legs long, slender, the posterior tibiæ with a terminal process which is straight in the ♂, contorted in the ♀. The ventral sexual marks consist of a large deep fovea near the apex, which has straight or convex anterior limits. Eyes (♀) lunate, small; the apex of the abdomen pointed, produced.

Habitat. A common species, occurring in the northern half of California, and in Oregon and Washington, as well as in the British possessions.

B. MONTICOLA, *Casey*. Black, shining, impunctate, antennæ, legs and palpi red, pubescence coarse. Length 2.2 mm.

Head as wide as long, eyes finely granulate, sides of the head behind them convergent, feebly arcuate, occiput carinate, occipital foveæ nude, elongate, situated on a line passing through the eyes, circumambient sulcus well impressed, the portions of the vertex outside of the sulcus with large shallow punctures, and carinate on the lateral declivity. Frontal margin deeply depressed between the broad and pubescent supra-antennal tuberculations. *Antennæ* not longer than the head and prothorax together; first joint slightly arcuate and cylindrical, twice as long as thick; second to eighth subequal, conico-cylindrical; ninth slightly transverse; tenth wider, transverse, not longer than the ninth and obliquely truncate, (♂) cuneate; eleventh slightly wider than the tenth and as long as the three preceding together, rounded at the base, obliquely conical toward the end, not acuminate. *Prothorax* widest near and before the middle, as wide and as long as the head, strongly arcuate, sinuate to the base behind; disk convex, smooth; median fovea large, prolonged for a short distance anteriorly; the lateral small, with lateral parallel longitudinal grooves; transverse sulcus arcuately limiting the leaf shaped anteriorly pointed elevation with its central puncture on each side of the median fovea and the basal median carina; the posterior

angles of the pronotum are deeply foveate. *Elytra* without visible punctures; shoulders prominent longitudinally, not acuminate; sutural lines parallel, interval with a row of very small punctures; discal lines short, obsolete. *Abdomen* very convex, the lateral basal pits very deep, feebly punctulate. Sexual differences are the same as in *B. zephyrinus*; the ventral fovea very large, crater shaped, with evenly concave bottom.

Habitat. Eldorado county, California.

B. CICATRICOSUS, *Brend.* Male, umber brown, elytra, legs, and last joint of the antennæ red, pubescence long. Length 1.9 mm. Plate X., Fig. 83.

Head quadrate, carinate at the sides over the eyes; vertex moderately convex, the carina of the collar scarcely continued to the base of the occiput, in the center inconspicuously compressed and surrounded by a deep sulcus, which is posteriorly continued to the base, running straight forward outside of the deep, nude, fovea, and connects with the sulcus of the other side by the deep transverse portion of the frontal impression; the border separated by the sulcus is coarsely but not densely punctured; front continuously declivous with the clypeus. Eyes rather prominent, small, with a lunate base. *Antennæ* as long as the head and thorax together; first joint cylindrical, concave above, convex beneath, deeply emarginate above at the tip; second shorter, as thick as the first, oval, longer than wide; third to eighth sub-equal, conico-cylindrical, inconspicuously longer than wide; ninth and tenth not longer but gradually wider, slightly transverse; eleventh nearly as long as the three preceding together, scarcely truncate at the base, with a tooth proceeding from the distal third, which, however, is not erect; pubescence long. *Prothorax* impunctate, widest across the anterior third; slightly longer than wide; sides irregularly sinuate behind, basal margin elevated in the shape of a sharp transverse carina; discal median sulcus a conspicuous, merely impressed line, originating in the deep, nude,

median basal fovea and extending one-fourth of the length from the neck. The arcuate transverse sulcus limits each side of the median fovea, a leaf-shaped elevation, inclining backwards, and surmounted anteriorly by a sharp-pointed tubercle; behind, and between this and the base is a small fovea. The lateral foveæ are deep, funnel shaped, near the margin, with the usual outwardly arcuate sulcus; behind and outside of the lateral fovea is a pointed tubercle, causing the irregular situation of the lateral margin. *Elytra* convex, coarsely, but not densely, punctured, the punctures shallow but conspicuous. The shoulders are remarkably high and angular, with a blunt tubercle; sutural lines parallel, sharp, the discal lines short, very fine, one-fourth long, on a slight, longitudinal depression. The basal foveolæ are three in number on each elytron. *Abdomen* impunctate, the basal fovea deep, carinæ obsolete, short; the basal segment is slightly longer than the fourth, and as long as the second and third together. Last ventral with deep rounded impression.

Habitat. Placer county, California. Discovered by Mr. Charles Fuchs.

B. ALBIONICUS, *Aubé*. Slender, narrow-shouldered, convex, body piceous-black or brown, elytra red, legs and palpi paler. Lenth 1.7 to 1.9 mm. Plate X., Fig. 84.

Head as wide as long, front concave between the prominent antennal tubercles, and anteriorly continuous with the clypeus, posteriorly limited by the circumambient sulcus, which ends near the base in a large, round, nude, fovea; vertex with a conspicuous oblong impression in the center, a minute hemispherical tubercle at the base; edge of lateral border rounded, not carinate, the frontal tubercle crossed obliquely by a short channel. *Antennæ* as long as the head and thorax; first joint cylindrical, slightly concave above, and convex beneath; second not narrower, obconical; second to sixth rounded, oblong, gradually smaller; seventh and eighth as wide as long, obconical; ninth and tenth transverse, obconical, rounded; gradually wider, not longer; eleventh as long as the three

preceding together; basal half nearly globular; apical half conical, subulate. *Palpi* yellow; second joint clavate; third globular; fourth fusiform, pointed at both ends, sharply acuminate, as long as the first and second antennal joints together. *Prothorax* longer than wide, median sulcus wanting; median fovea deep, connected with the lateral ones by an arcuate sulcus each side; lateral sulcus sharp, separating the convex disk from the convex marginal lobe; behind the fovea and basal margin is a small carina, and on each side a punctiform fovea. *Elytra* convex, scarcely wider across the shoulders than the base of the prothorax; suture one-fourth longer; the width across the tip is one-half greater than that of the prothorax; sides divergent, arcuate behind the middle; shoulders low, not prominent; sutural lines not close, straight, punctate; discal lines short, not reaching one-fourth the length; disk extremely minutely and faintly punctulate. *Abdomen* nearly as wide as the elytra; basal segment more than one-third as long as wide; carinæ short, separated by one-third the segmental width; lateral depression ample. Tarsi with the second and third joints equal in length. ♂, last antennal joint with a basal tooth; last ventral with a round shallow impression. ♀, last dorsal acutely produced behind.

Habitat. British Columbia.

B. OCCIDUUS, *Casey*. Brownish-red; slender, polished; pubescence coarse. Length 2 mm. Plate X., Fig. 85.

Head impunctate, broadly convex, eyes small, foveæ large, deep, and nude, frontal lateral tubercles large. *Antennæ* as long as the head and thorax together, with the ninth joint slightly transverse, the tenth strongly transverse; the last twice as wide as the ninth and as long as the three preceding ones together, truncate at the base, oblong-oval, obliquely acuminate. *Prothorax* as long as wide, with a deep, nearly entire median sulcus. *Elytra* with narrow shoulders, obsoletely punctulate. *Abdomen* as wide as the elytra, the basal segment slightly longer than one-third its width, with three equal transverse pubescent basal foveæ, and without carinæ. ♂, last

antennal joint with a short basal tooth; last ventral with a shallow transverse oval impression.

Habitat. Humboldt county, California.

B. SCHAUMII, *Aubé*. Piceous black, coarsely punctate, pubescence long; antennæ and legs paler than the body; palpi red. Length 2.1 mm. Plate X., Fig. 81. Plate XII., Fig. 136.

Head as wide as the prothorax, smooth on the vaulted vertex, without carinæ, two deep nude foveæ between the prominent eyes, and with a well impressed parabolic sulcus separating the broad lateral border from the vertex; edge of the lateral border carinate, and between it and the eyes is a longitudinal carina; front concave, frontal tubercles prominent; clypeus simple, continuous with the declining part of the concave front and bearing in the middle a retuse tooth. *Antennæ* longer than the head and thorax together, robust, the three basal joints thick, nearly quadrate, subequal; the three succeeding ones are oblong, rounded; seventh joint transverse, eighth smallest, rounded; ninth and tenth obconical, gradually larger, as long as wide; eleventh as long as the two preceding, twice as wide as the ninth, acute-ovate; ♂ with the last joint bearing a strong tooth at the base, seventh with the tooth outside. *Prothorax* as long or slightly longer than the head, widest in the middle; median sulcus sharply cut near the base, shallow anteriorly, evanescent before the middle; median fovea deep, limited behind by the acute end of a basal carina; the lateral crests not interrupted, ending before the middle, and limited near the base by a small acute tubercle: lateral sulcus issuing from the lateral fovea, lost anteriorly in the depressed border, and limited with the fovea behind by another very acute tubercle, making in all five basal spines. *Elytra* very coarsely punctured, widest behind the middle, the sutural length equal to the elytral width, sides divergent, disk very convex posteriorly. *Abdomen* less strongly punctured, the marginal basal triangle very broad, basal carinæ conspicuous, lateral depression wide and deep; the fourth dorsal segment longer than the third. Legs punctured. ♂, interme-

diate trochanter with a slender spine; posterior tibia arcuate.
Habitat. Pennsylvania and Illinois.

B. RIPARIUS, *Aubé*. Bright red, slender, strongly punctured, pubescent. Length 1.4 to 1.6 mm. Plate X., Fig. 80. Plate XII., Fig. 140.

Head a little wider than long, finely scabrous; margin broad, flat, produced in front, and minutely emarginate above the insertion of the antennæ; vertex vaulted, the crest not more than indicated, the lateral foveæ small, deep and nude. In the ♀ the front is declivous anterior to the interantennnal line. *Antennæ*, ♂, half the length of the body the first joint cylindrical; second to eighth gradually smaller and rounded; ninth much larger than the eighth and irregularly transverse, toothed outside; tenth larger, globose; the eleventh not as thick, but more than twice as long, straight inside, convex outside, with a large tooth inside of the base, which is turned backwards. ♀, antennal joints regular, the last joint not as long as the two preceding ones, regularly acute-ovate, not toothed. *Prothorax* little longer than broad, punctured; the impressed longitudinal lines fine, sharply cut; the basal fovea small but conspicuous; the basal tubercle and the linear discal crests not prominent but easily discernible. *Elytra* very convex, punctured, longer than broad; shoulders blunt, discal lines none, sutural line straight, the interval darker, sculptured. The abdominal dorsal basal impressions are deep, nearly equal; elytra in the female less deeply punctured. Legs deep orange, punctured; the spur of the posterior tibia is very long in perfectly preserved specimens, but may be broken or entirely lost in others.

Habitat. Country along the Ohio river.

B. SCABRICEPS, *Lec.* Piceous, legs, antennæ, and palpi paler. Length 1.9 mm. Plate X., Fig. 86. Plate XII., Fig. 138.

Head scabrous, broader than long; vertex slightly convex, carinate on the occiput, with the sulcus very faint, or indicated.

by four punctiform impressions. The front is produced, emarginate at the apex, bilobed, the declivous portion perpendicular; in the middle is a nearly round excavation with sharp edges, from which emerges a small horizontal tooth. Clypeus a transverse vaulted elevation without further sculpture; labrum transverse, emarginate. *Antennæ* half as long as the entire body, the joints cylindrical, decreasing in size; the seventh longer than its neighbors, the eighth much smaller; ninth obconical, larger; tenth globular, as thick as the last, one-half longer than wide, and very acutely pointed. *Prothorax* slightly longer than wide, widest before the middle, where the sides are arcuate; from this point the sides are nearly straight to the neck and slightly sinuate posteriorly to the base; the disk is convex, the middle sulcus shallow, nearly entire, discal crests not prominent, basal tubercles acute; posterior to the median basal is a small carina running to the base; the lateral foveæ are irregular, lateral sulcus a slightly impressed line, leaving the marginal part of the disk continuous with the vaulted discal surface. *Elytra* convex, punctured, one-fourth longer than the prothorax, slightly narrower across the high prominent unarmed shoulders, and one-fourth wider across the disk behind the middle; sutural lines straight, close to the suture, interval punctured, shallow, discal impressions scarcely one-fourth of the elytral length. *Abdomen* with the basal lateral impressions very deep and large, the middle one small, the carinæ conspicuous and sharp, the marginal triangle broad at the base; the last ventral of the ♂ has a deep circular impression. Legs strong; spine of the posterior tibiæ very long. ♀ *antennæ* shorter, tenth joint obconical, front not produced, continuous with the clypeus.

Habitat. Pennsylvania, Illinois, Iowa.

B. LINEATICOLLIS, *Aubé*. Dark piceous, coarsely pubescent, antennæ and palpi dark red. Length 2.2 mm. Plate X., Fig. 87.

Head very flat, compressed between the vertex and the under surface, width, including the eyes, equal to the

length. Sides parallel from the obliquely transverse tempora to the antennal tubercles; front produced into a triangle; eyes conical; occiput not elevated, with a short carina at the base; between the eyes are two slightly impressed foveæ; the sulcus scarcely visible; the triangular part of the front, anterior to the inter-antennal line, is obliquely declivous in a line with the porrected clypeus; the whole upper surface scabrous. *Antennæ* pubescent, robust, as long as the head and prothorax together; first joint obconical, twice as long as the second and of equal width; second to fourth joints equal, wider than long; fifth to eighth equal, as thick as the preceding, rounded, as long as wide; ninth wider, obconical; tenth (♂) large, globose, as wide as the last joint, which is ovate; tenth (♀) oval, transverse, wider than the ninth; the last ovate, thicker than the tenth, pubescent, with short, coarse hair. *Palpi* with the last joint straight inside, arcuate outside. *Prothorax* as wide as the head, length and width equal, widest before the middle, evenly convex from side to side, punctate, base twice as wide as the neck, carinate in the middle to the deep median fovea; median sulcus deep, nearly entire, the transverse sulcus interrupted by the discal carinæ and the acute tubercles each side of the median fovea; discal carinæ entire, crenulate, and continued to the base behind the spinous tubercle; lateral sulcus entire, ending behind in a large lozenge-shaped fovea. *Elytra* thinly punctulate, length equal to that of the prothorax plus one-half the head; the width across the low spinous shoulders is one-sixth greater, and across the tip two-thirds greater than that of the prothorax. Basal foveæ three, small, deep, conspicuous, discal lines very fine and sharp, but inconspicuous, not reaching beyond the humeral elevation; sutural lines straight, convergent, the intervals very regularly punctured. *Abdomen* densely pubescent, very convex, the basal segment much depressed at the base, the triangular margin broad at the base; the carinæ are one-third the length of the segment and one-fifth of the width; the fourth dorsal is longer, the last (♀) acute at the tip, not produced.

Legs long, robust, the tibiæ longitudinally carinate, the thighs below longitudinally sulcate.

Varies in the punctuation, being sometimes very faint.

Habitat. Pennsylvania.

B. BISTRIATUS, *Lec.* Dark red-brown or dark piceous, polished; legs and antennæ dark red. Length, 2.1 mm.

Head flat, as long as wide, not convex above, occiput slightly carinate, occipital foveæ small, the connecting sulcus shallow, the enclosed space smooth, the excluded margin broad, scabrous; the frontal margin is triangularly produced and continuous with the clypeus; eyes prominent, conical. *Antennæ* as long as the head and prothorax together, third to eighth joints equal, quadrate, ninth and tenth obconical, gradually larger, the last ovate, acuminate. *Prothorax* punctulate, the median sulcus obsolete, no carinæ. *Elytra,* angulate at the shoulders, convex, punctured. Legs long, ♂ with a spur at the end of the intermediate tibia.

Habitat. Pennsylvania.

B. FRONTALIS, *Lec.* Brownish-red thinly pubescent, impunctate. Length, 2.4 mm. Plate X., Fig. 88. Plate XII., Fig. 134.

Head of ♂, from the apex of the triangularly produced frontal margin to the base, as long as the width of the head including the eyes; in the ♀ it is shorter and the frontal margin is straight between the antennæ. Two small foveæ between the eyes are connected by a sulcus running along the margin; vertex and occiput elevated behind, depressed toward the frontal margin; face, below the overhanging front, with a horizontal spine, and two acute tubercles on the carinated clypeus; antennal foveæ small. *Palpi* yellow, third joint triangular. *Prothorax,* length and width equal, broadest before the middle, tri-sulcate near the base; at the posterior end of the groove are three foveæ, between which are two blunt pointed tubercles; disk smooth, not carinate. *Elytra* and abdomen not perceptibly punctured, thinly pubescent, the former,

when taken conjointly, broader than long, narrow-shouldered, arcuate behind the middle, sutural lines entire, dorsal lines well impressed at the base, abbreviated before the middle; shoulders rounded, unarmed. *Abdomen* with the first dorsal three times as wide as long, bearing three transverse basal impressions, of which the middle one is smaller; the triangular margin is very narrow. Legs long, posterior tibiæ with a long, needle like spur; the ♂ tibiæ are thicker and slightly curved; antennæ with the joints cylindrical, decreasing in thickness from the first to the seventh; the eighth, ninth, and tenth, obconical, gradually larger, the eleventh acute-ovate. ♀ antennæ of the same form but shorter.

Habitat. Between the thirty-sixth parallel and the lakes.

B. SIMPLEX, *Lec.* Red or reddish yellow, polished; pubescence sparse. Length, 1,9 to 2 mm.

Head of ♂ longer than wide, the frontal margin produced, retuse, front concave behind the margin; vertex broadly convex, smooth, foveæ small, nearly nude, the circumambient sulcus very shallow at the sides and in front; the part outside of this sulcus is finely scabrous. In the ♀ the frontal margin is not produced and the entire vertex is smooth. *Antennæ* regular, with no sexual marks. *Prothorax* with the middle and lateral grooves deep, the two tubercles near the base stout, acute, and on each side near the basal angles are two small acute teeth; the lateral margin is flat from the bottom of the lateral groove outward. *Elytra* indistinctly punctulate, the shoulders acutely angulate, disk convex, sutural lines parallel, the discal ones hardly more than shallow, longitudinal, short impressions, from the third or external basal puncture. *Abdomen* polished, impunctate, the three basal, pubescent, transverse impressions equal in width, the median separated by two distinct short carinæ. Legs slender, the posterior tibiæ with a long terminal spur.

Habitat. Northern Illinois, near Lake Michigan.

B. GLOBOSUS, *Lec.* Red brown, polished, punctulate; pubes-

cence long, not dense. Length, 1.7 mm. Plate X., Fig. 89. Plate XII., Fig. 135.

Head convex, vertex roof-shaped, cristate at the top, smooth, interocular foveæ deep, round, nude, circumambient sulcus conspicuous, margin broad, flat, strongly punctured, with the lateral edge carinate; the ♂ has the frontal margin arcuate-triangular, continuous with the lateral border, notched at the apex, overhanging the clypeus, which is separated from the frontal margin by a deep, transverse excavation, and rises from the middle of the base of the labrum as a three-sided truncate prism with the median side concave, curved upwards; the sides of the clypeus are angular, the upper external angle retuse, in appearance as lateral horns. *Antennæ* half as long as the entire margin, first joint cylindrical, thicker than the succeeding ones, roundly emarginate at the tip above for the genuflexion with the second joint, which is of the same width as the succeeding seven, obconical; third to eighth globular; ninth, thicker, transverse; tenth four times as thick as the ninth, globular, not perceptibly flattened on the lower surface and with a circular fovea near the base; eleventh narrower than the tenth, ovate, acute, obliquely impressed from the middle on the outside. *Palpi* yellow, last joint fusiform as long as the two basal joints of the antennæ. *Prothorax* slightly wider than long, widest before the middle, where it is acutely arcuate, anteriorly convergent, posteriorly very slightly sinuate; the base is very little wider than the neck, median sulcus deep, abbreviated near the neck, ending on the posterior fourth in a deep fovea, from which point the transverse sulcus branches out arcuately to the irregular lateral foveæ; the basal elevated lobes are limited anteriorly by the transverse sulcus and pointed, each with a punctiform fovea in the middle; the discal carinæ are interrupted near the sulcus; lateral sulcus short. *Elytra* very convex, punctulate, one-half longer than the prothorax, sides strongly arcuate, sutural lines close, straight, base tri-foveate, discal lines shallow, short, or absent. *Abdomen* narrower than the elytra at

the base, the transverse impression deep, the middle one the smallest, carinæ short; the basal segment is nearly twice the length of the second, the lateral triangular borders of the segments narrow. Legs long, thighs clavate, posterior tibiæ with a long spinous process, the intermediate ones in the ♂ with a short process at the end. ♀, frontal margin straight between the antennæ, declivous towards the simple clypeus. *Antennæ* shorter, the tenth joint rounded, obconical, little thicker than the ninth.

Habitat. East of the Mississippi river.

This species is the type of a series of forms which have the following characters in common: The occipital foveæ are nude, the tenth joint of the ♂ antenna, is large, globular, of similar form, more or less flattened beneath, and with a deep, sharply defined fovea near the base. The species now known of this group are as follows: *B. globosus*, *B. spretus*, *B. foveicornis*, *B. punctifrons*.

B. VIRGINIÆ, *Casey*. Black, shining; elytra dark red; antennæ and legs brown, palpi lighter; pubescence abundant. Form as in *B. denticollis*. Length, 2 mm. Plate XII., Fig. 139.

Head large, quadrate, eyes small, far below the surface of the nearly flat vertex; occiput with a short carina, vertex with two small, nude foveæ connected by an arcuate, slightly impressed, sulcus. The portion of the head outside the sulcus is finely and densely punctured, the frontal margin slightly elevated in the middle; antennal portion flat, declivous in front, with the usual setose, lateral, dentation; the lower part of the declivity is produced in the middle horizontally, as a triangular horn, which is notched at the tip and overhangs the deep interantennal excavation; in the middle of the anterior margin of the clypeus is a small rounded tubercle crowned with two tufts of hair; the lateral margin is angular and slightly retuse; the posterior part of the head is impunctate. *Antennæ* with the first joint arcuately cylindrical, twice as long as wide, as long as the second and third together;

second slightly thicker and longer than the third; the succeeding joints, to the ninth, are equal, quadrate, the ninth slightly obconical, transverse; the tenth is large, globular, not compressed, and with a basal fovea; eleventh as wide as the tenth and as long as the three preceding joints, obliquely acuminate. *Prothorax* longer than wide, median sulcus nearly reaching the neck, lateral foveæ large, pubescent, basal tubercles acute, anteriorly continued as feeble carinæ on either side of the median sulcus. *Elytra* feebly and sparsely punctulate, humeri not acute, prominent. *Abdomen* with the basal carinæ approximate, femora fusiform, slender, the claws of the anterior ♂ tarsi cleft.

♀ antennæ with the ninth and tenth joints gradually larger, rounded; clypeus continuously declivous with the frontal margin.

Habitat. Virginia.

B. SPRETUS, *Lec.* (*B. luculentus, Casey.*) Piceous-black, elytra often dark red; antennæ brown, paler at the tip; legs red, palpi yellow. Length, 1.7 mm. Plate X., Fig. 92.

Head wider than long, wider than the prothorax, slightly convex, punctulate in front, smooth behind, eyes near the base, prominent; foveæ nude, deep, mutually twice as distant as either from the eye; sulcus fine, conspicuous, but evanescent anteriorly, occiput elevated, vertex lower towards the front which is declivous between the antennæ, the declivity broadly impressed each side, hairy, bidentate in the middle below, a deep and very narrow interantennal sulcus separating it from the clypeus which is convex, granular, with simple edges similar to those of *B. scabriceps*, except that it has a small tubercle near the upper edge in the middle. Labrum emarginate. *Antennæ* as long as the head and prothorax together, basal joint obconical, more convex beneath, and as long as the two succeeding; second to eighth oblong, gradually shorter, the eighth transverse; ninth longer and wider, transverse; tenth large, quadrate-rounded, flattened beneath, twice the width of the neck, with a circular hole in the flattened surface;

eleventh narrower than the tenth, ovate-acuminate. *Prothorax* slightly longer than wide, widest before the middle, median basal fovea small, no median sulcus nor crests; lateral sulcus shallow, feeble; the basal tubercles are minute, and behind them each side is a punctiform fovea. *Elytra* convex, impunctured, the suture as long as the width behind the middle; across the low unarmed shoulders, as wide as the head. *Abdomen* with the basal lateral impression broader than the middle one, carinæ conspicuous, rather long. Legs long, ♂ intermediate tibiæ spurred, posterior feebly arcuate, also spurred. ♀ with the front gradually declivous not separated from the simple convex clypeus, the tenth antennal joint not much longer than the ninth.

Varies in color being sometimes more reddish or not fully colored.

Habitat. Virginia, Ohio, Kentucky.

B. FOVEICORNIS, *Casey*. Form, color and size as in *B. spretus*, differing in the clypeus having a very minute tubercle near the narrow sulcus below the frontal margin, which margin is again like *spretus*. *Antennæ* of the same form but with the tenth joint more flattened beneath and the fovea larger; the prothorax has a faint very short median sulcus, the discal carinæ hardly discernible, the lateral sulcus appearing as a very fine line, outside of which the surface slopes to the margin.

My material consists of six specimens of *B. spretus* and one of *B. foveicornis* from Cincinnati, Ohio, which I can hardly separate, as the *spretus* vary in the direction of Casey's *foveicornis*, the description of which answers exactly to my specimen.

B. PUNCTIFRONS, *Casey*. Not known to us, but the description indicates the same relation to *spretus*, which varies in the form of the tenth antennal joint, being in some smaller and irregularly formed and with the fovea obliterated.

B. DENTICOLLIS, *Casey*. Form and color, sculpture of

prothorax and elytra, as in *B. virginiæ*, but the humeri are acutely pointed, the pubescence is coarser and not so dense. Length, 1.8 mm. Plate X., Fig. 93a. Plate XII., Fig. 137.

♀ *head* wider than long, eyes small, vertex elevated above the eyes, laterally carinate, flat above, occipital foveæ large, pubescent, mutually twice as distant as either from the eye; circumambient sulcus feeble, enclosed surface, and that behind the sulcus convex; occiput carinate; supra-antennal elevation punctured, frontal margin depressed and emarginate in the middle, the lateral, pendant, lobes setose; from the lower part of the emargination emerge two small shining teeth, below which, and separated by the interantennal excavation on the clypeus, rises an elongated tubercle bearing two tufts of hair; the sides of the clypeus are reflexed, surface below the tubercle conical, with a triangular depression each side near the tubercle; labrum constricted at the base. *Antennæ* with the basal joint triangular, carinate above, emarginate at the tip, the triangular pendant lobe rounded at the free angle; second joint two-thirds as long as the first, obconical, third shorter nearly quadrate; fourth to seventh equal, eighth shorter, ninth transverse, slightly cuneate internally; tenth large, globular; eleventh as thick as the tenth, and as long as the ninth and tenth together, rounded at the base, conical, acutely pointed at the ends. *Abdomen* with two short carinæ at the base, mutually more distant than in *B. virginiæ;* thighs thicker, tarsi very slender, claws simple.

♀ antennæ regular, clypeus not separated from the simple frontal margin, obsoletely carinate in the middle; anterior margin finely retuse, entire, surface strongly punctured.

Habitat. Virginia; Iowa.

B. TRIANGULIFER, *Brend.* Shining black, densely pubescent. Elytra, marginal rounded angle of the prothorax, and supra-antennal tubercle, in sunlight blood-red, antennæ, palpi and legs rust-red. Length, 2. mm. Plate X., Figs. 91 and 93b. Plate XII., Fig. 133.

Head quadrate, vertex smooth, but slightly convex, with an

entire, countersunk, fine carina, circumambient sulcus conspicuous, ending posteriorly in round spongious foveæ, twice as distant as either from the eye; lateral margin overhanging the eyes by its sharp carinate edge, punctate, more so on the frontal margin. The front is narrowly concave in the middle, and divided by a fine impressed line, declivous anteriorly to the inter-antennal line, the declivity bilobed, and beset with long convergent hairs; between these hair pencils, from the depths of the emargination, two pairs of small triangular teeth emerge, the outer ones smaller, inconspicuous. Subfrontal excavation deep, from the bottom of which a broad, triangular, horizontal tooth stretches out, resting with the acute point on the tip of the conical clypeal tuberosity, the base of which rests again on the transverse labrum; the cone is just perceptibly higher than broad at the base, and laterally separated by a groove from the lateral expansion (wing) of the clypeus, which is concave, with a retuse angulated margin. The profile of the face resembles somewhat the form of a sheep's face. *Antennæ* ♂ longer than head and prothorax, first joint as long as the third, and more than twice as long as the second, triangular, the free angle thorn-like, pendant; second transverse, just visibly broader than long; third a little thicker than the second; fourth to eighth obconical, gradually shorter; eighth quadrate; ninth transverse, truncate at the base, obconical; tenth larger, globose, as thick as the eleventh, which is conical, as long as the two preceding together, obliquely pointed. In the ♀ the frontal margin is interrupted in the middle, continuous with the clypeal surface, which is roundly margined anteriorly. The first antennal joint is convex below, the third obconical, longer than wide, longer than the second or fourth; tenth not as thick as the last joint, which is two and one-half times longer, rounded at base, pointed at tip. *Prothorax* as long as wide, median sulcus deep, ending abruptly one-fourth from the neck, which is carinate. Discal crest sharp, interrupted before the small, sharp-pointed tubercles, which are nearer to the base than

usual. Lateral sulcus entire, separating the smooth lateral margin, which is nearly horizontal on its widest part, narrowing and declining backward to the shallow lateral fovea. The discal space between the crests and the lateral sulcus is uneven with shallow longitudinal impressions. Between the lateral fovea and the tubercle is another small tooth prolonged anteriorly into a very short second crest. *Elytra* not punctured, shoulders high, with a very small spine, dorsal lines faint, very short, basal punctures indistinct, the sutural impressed lines parallel. *Abdomen* very convex, the basal depression between the short and prominent carinæ narrower than the lateral depression; last ventral in the ♂ impressed at the base, the penultimate impressed transversely at the tip; in the ♀ the last ventral is longitudinally rugose at the sides. Legs moderately long, tibiæ slightly curved, the posterior one with a thin process.

Habitat. Long Island

B. NIGRICANS, *Lec.* Black, polished, impunctate, pubescence thin, antennæ, palpi, and legs red. Length, 2 mm. Plate X., Fig. 93c.

Head as long as broad, narrower in front, the lateral margin with sharp edges, carinate, front punctate, in the middle with two small teeth, vertex convex, carinate, occipital foveæ pubescent and mutually twice as distant as either from the eye, circumambient sulcus deep; occiput carinate. *Antennæ* red (♂) first joint arcuately cylindrical; second smaller, obconical, as long as wide; third thicker and longer than the second, the outer side straight, the inner convex, dilated; fourth half as wide and about as long as the third; fifth to eighth subequal, as wide as long; ninth larger, rounded; tenth nearly twice as thick as the ninth, globose; eleventh one-half longer, acute, ovate. *Prothorax* with the median sulcus very deep, the basal tubercles very acute with a short basal median carina; lateral foveæ pubescent, lateral sulcus deep, discal carinæ obsolete. *Elytra* impunctate, shoulders subacute, sutural inter-

val punctured, discal lines abbreviated before the middle. *Abdomen* impunctate, convex. Legs dark red.

♀ antennæ with the third joint not dilated, longer than the second, tenth obconical, usually not enlarged, the clypeus continuous with the declivity of the front.

Habitat. Georgia.

This is the representative of another series of species, having the occipital foveæ pubescent, the tenth joint not compressed, large, without a basal fovea. To this group belong *B. nigricans*, *B. triangulifer*, *B. denticornis* and *B. cephalotes.*

B. CEPHALOTES, *Casey*. Piceous-black, legs and antennæ red; pubescence long, surface polished. Length, 2 mm. Plate X., Fig. 90. Plate XII., Fig. 132.

Head quadrangular, with the corners rounded, somewhat wider than long, occiput convex, sometimes bearing in the middle a very faint, short, carina; the eyes are small, prominent, tempora arcuate; the occipital foveæ are pubescent, the connecting groove circumambient in the ♂, obsolete in front in the ♀, space between them polished, smooth, with a faint central impression, the separated margin broad, coarsely and sparsely punctured in front, where, in the male, it overhangs the clypeus; in the middle it is declivous and finely notched, the declivous part with a central emargination; the triangular lobes thus formed are setiferous, and separated from the clypeus by a deep interantennal excavation; from the bottom of the emargination emerges a serrate (quadridentate) plate; the clypeus bears in the middle an ovoid tubercle, provided at the apex, just beneath the tooth plate, with two divergent tufts of hair; the lateral margin of the clypeus is angulated and reflexed; the labrum is broadly emarginate. *Antennæ* stout, the basal joint strong, longer than wide, convex below, slightly transversely concave above; second oblong, smaller; third to eighth still smaller, globular, ninth transverse. Tenth very large, truncate in the ♂, subglobular; the last, at least as wide as the tenth, ovoid, acuminate; in the ♀ the tenth joint

is rounded and not so large. *Prothorax* widest before the middle, sides subangulate, sinuate towards the base, as long as wide; the disk is tri-sulcate and bicarinate, the basal tubercle on each side of the foveate posterior portion of the median sulcus sharp, lateral foveæ large, pubescent. *Elytra* very feebly punctulate, shoulders acutely angulate; disk convex, discal line short. *Abdomen* highly polished, pubescent, the basal carinæ strong and short. Legs long, thighs clavate, posterior tibiæ with a long terminal spur.

Habitat. Massachusetts to the Missouri river, north of the Ohio.

TRIMIUM, *Aubé*.

Elytral base bifoveate, no subhumeral fovea, head larger.

SYNOPSIS OF THE SPECIES OF TRIMIUM

Eyes nearly in a level with the vertex; pronotal foveæ and sulcus deep, - - . - - - - - - *foveicolle, Lec.*

Eyes far down on the sides of the head.

a² Prothorax wider than long, less convex.

Head with a deep arcuate impression; antennæ not longer than the head, last joint one-third the length of the whole antenna; elytral discal lines short. Length, 1.5, mm. - *globifer, Lec.*

Head with the foveæ not connected by a sulcus; antennæ longer than the head; last joint acute; elytral dorsal line half the elytral length. Length, 1.3 mm. - - *impunctatum, Br.*

a¹ Prothorax longer than wide, more convex.

b² Lateral foveæ and sulci of prothorax large and deep.

Occiput concave, not channelled, pronotum punctured, ely tral discal lines very short. Length, 0.9 mm. - *puncticolle, Lec.*

Occiput channelled, pronotum impunctate. Length, 0.9 mm. *discolor, Lec.*

b¹ Lateral foveæ small.

c² Width across the shoulders as great as that of the prothorax.

d² Transverse sulcus deep.

Occiput impressed, impunctate, head as wide as the prothorax. Length, 1.0 to 0.9 mm. - . - - *parvulum, Lec.*

Occiput impressed, prothorax punctured, wider than the head. Length, 0.9 mm. - - - - - - *thoracicum, Br.*

Occiput convex, not impressed, carinate, head as wide as the prothorax, frontal margin channelled, circumambient sulcus angulated. Length, 0.8 mm. - - - *convexulum, Lec.*

d^1 Transverse sulcus faint.

Head smooth, with a deep angulated impression, occiput convex not impressed. Length, 0.5 mm. - - *simplex*, *Lec.*

c^1 Width of the shoulders less than that of the prothorax.

Occiput not channelled, head distinctly punctulate; in the middle, before the line of the eyes, is a rounded tubercle. *dubium*, *Lec.*

Occiput impressed, sulcus angulated on the frontal margin; transverse pronotal channel deep, elytral lines faint. Length, 0.6 mm. - - - - - - - *americanum*, *Lec.*

T. FOVEICOLLE, *Lec.* (Leconte's description.) Elongate, bright rufo-testaceous, very slightly pubescent.

Head convex, smooth, with a fovea each side above the eyes, and a transverse angulated impressed line. *Prothorax* longer than wide, convex, with three sub-basal foveæ, connected by a transverse impressed line; the lateral foveæ are larger, and situated on the declivity of the sides. *Elytra* bifoveate at the base, sutural line deep, dorsal one short. *Antennæ* with ninth and tenth joints transverse. Length, 0.9 mm.

Habitat. Massachusetts. Unknown to us.

T. GLOBIFER, *Lec.* Yellowish brown, impunctate, form slender, pubesence thin, inconspicuous. Length, 1.5 mm.

Head comparatively small, with two large foveæ behind and between the eyes, the connecting sulcus semi-circular; eyes small, oblong. *Antennæ* very little longer than the head, the basal joint cylindrical, longer than the second; third to ninth very small, gradually transverse; the tenth wider, disk-shaped; the last very large, oval, nearly half as long as the funicle. The last joint of the maxillary palpi is also very large. Prothorax as wide as long, less convex, rounded at the sides, narrower behind, with the lateral foveæ connected by an arcuate sulcus. *Elytra* longer than wide, widest behind the middle, convex, dorsal impression short, sutural line deep. *Abdomen* not carinate at the base.

Habitat. Georgia, South Carolina.

T. IMPUNCTATUM, *Brend.* Red-brown, pubescence thin. Body impunctate, polished. Length, 1.3 mm. Plate XI., Fig. 98.

Head narrower than the prothorax, about as long as wide, tempora not prominent, convergent, eyes not prominent, sides but slightly divergent towards the tempora; occiput not impressed, convex, foveæ oblong, no circumambient sulcus, frontal margin straight, frontal tubercle flat, not prominent. *Antennæ* shorter than the head and prothorax together, first joint twice as long as wide, obconical; second quadrate narrower than the first, third to eighth very small, transverse; ninth and tenth gradually much wider, not longer than the preceding one, the last large, ovate. *Palpi* small, the third joint obliquely rounded, larger than the last joint, which is obliquely conoid with rounded sides, or truncate ovate. *Prothorax* slightly wider than long, widest across the middle, base two-thirds, neck about one-half of the median width; disk not as concave as in the other species, the basal sulcus slightly impressed, one-fourth from the base, foveæ rather shallow. *Elytra* rather high-shouldered, the sides slightly arcuate, divergent behind, slightly wider across the shoulders than the prothorax, one-fifth wider across the tip; suture slightly shorter than the apical elytra width, disk convex, bifoveate at the base, discal lines fine, half the elytra length. *Abdomen* longer than the elytra, the first three segments of nearly equal width, and subequal in length, with two short basal carinæ. Legs rather short.

Habitat. Virginia, Maryland.

T. DISCLOR, *Lec.* Convex, of the form of *T. dubium*, but slightly smaller, of a rich dark brown color, the abdomen piceous-brown. Length, 0.9 mm.

Head, as wide as the prothorax, the occipital foveæ small, connected by an arcuate sulcus, occiput channeled in the middle or with a median impression, vertex punctate. *Prothorax* longer than wide, impunctate, basal sulcus angulate in the middle, deeply impressed, terminating in large lateral foveæ

which are not in view from above. *Elytra* convex, impunctate, the basal fovea of the sutural line smaller than the rather large fovea of the discal impression. *Abdomen* not carinate at the base.

Habitat. Gulf States. Not known to us.

T. PUNCTICOLLE, *Lec.* Red-brown, convex.

Head with the occiput not impressed in the middle, the foveæ small, connected with the middle of the frontal margin by nearly straight grooves. *Prothorax* convex, longer than wide, widest near and before the middle line, the lateral foveæ large, connecting sulcus deep, scarcely angulate in the middle; the disk finely and distinctly punctulate. *Elytra* wider behind, with two large basal foveæ, sutural line deep, discal line very short. Length 0.9 mm.

Habitat. Arizona. Not known to us.

T. THORACICUM, *Brend.* Saturated yellow; form slender; pubescence very fine, abundant. Length, 0.9–0.95 mm. Plate XI., Fig. 95.

Head narrower than the prothorax, one-fifth wider than long, tempora convergent, eyes not prominent, base impressed in the middle, frontal margin straight, a little more than half as wide as the width across the eyes; the foveæ are in a line with the middle of the eye, mutually less than twice as distant as either from the eye, circumambient sulcus distinct, shallow, antennal tubercles small. *Antennæ* one-half longer than the head, the two basal joints not as strong as in *T. parvulum;* eighth to tenth equal in length, each twice as wide as the preceding one, the last one-fourth longer than its width and twice as wide as the tenth, ovate. The last palpal joint in outline securiform, but not compressed. *Prothorax* as long as wide, seemingly longer, equal to one and one-half times the length of the head, widest before the middle, sides evenly arcuate, not perceptibly sinuate near the rather small lateral foveæ which are connected with the small medial basal fovea by a straight sulcus one-fourth the length of the prothorax from the base; disk evenly convex, finely and densely punc-

tured. *Elytra*, across the rounded shoulders, as wide as the prothorax, before the tip one-third wider and the suture one-fourth longer; disk convex, base with two arcuate impressions, leaving between them a broad longitudinal ridge, which in proper light may be traced to one-third the elytral length. *Abdomen* with the first segment not longer than the second, very convex with two very short basal carinæ. Legs moderate, the intermediate thighs lunate, convex anteriorly and nearly straight posteriorly, compressed. The abundant pubescence makes the surface appear lustreless.

Habitat. Illinois, Iowa. On moist rotten wood with ants. Abundant in the time of copulation in June. Differs from *T. puncticolle* by the impression on the occiput and the presence of abdominal carinæ.

T. PARVULUM, *Lec.* Yellow, polished throughout, pubescence not perceptible except under a magnifying power of over sixty diameters. Length, 1.00 mm. Plate XI., Fig. 97.

Head one-fifth wider than long, tempora prominent, angularly rounded, transverse behind, eyes not prominent, frontal tubercles strong, intermediate margin very nearly straight but slightly wavy; lateral margin straight from the tempora to the frontal margin; in a line through the middle of the eyes are two deep foveæ, three times as distant from one another as from the eyes; circumambient sulcus deep, transverse in front; occiput convex, impressed in the middle at the base. *Antennæ* with the two basal joints stout, three times as wide as the third; third to eighth moniliform, very small; ninth and tenth rapidly increasing in width, not longer; last, twice as wide as the tenth, ovate-conical, not acuminate. *Palpi* with the last joint thick, unsymmetrical. *Prothorax* as long as wide, the width equal to that of the head; sulcus double, deep; sides arcuate one-fourth from the base, where they are slightly sinuate, otherwise nearly spherical. *Elytra* with the discal line extending one-half the length; base of abdomen bicarinate. Legs not compressed, intermediate thighs regular.

Habitat. Illinois, Iowa.

T. CONVEXULUM, *Lec.* Deep yellow, very convex, more slender than the other species, pubescence not visible; body impunctate, highly polished. Length 0.7 mm. Plate XI., Fig. 94.

Head nearly as wide as the prothorax, frontal margin arcuate between the antennæ, width across the tempora one-fourth less; foveæ and sulcus deep, the latter dilated in front; occiput carinate. *Antennæ*, from the base of the first joint to that of the last, as long as the head, last joint about half as long, oval, three-fourths as thick as long, with short pubescence. *Palpi* with the last joint more oval, oblong. *Prothorax* longer than wide, sides sinuate near the base, the transverse sulcus deep, slightly and very broadly angulated in the middle, lateral foveæ none. *Elytra* convex, bifoveate at the base, the elevations between them not so high as in *dubium*. *Abdomen* as in *dubium*, but the first dorsal segment is much longer than the second, with two short basal carinæ and lateral basal depressions as in *Batrisus*. The fourth and fifth dorsals are connate, the contiguous limits scarcely discernible; ventrals correspond in length with the dorsals. Legs slender. Sexual differences of the clypeus as in *dubium*.

Habitat. Illinois, Pennsylvania, Florida.

This species answers better to the description of the genus *Trimium* than the others, if we assume as characteristic the length of the abdominal rings, while all the other species would coincide with Mr. Reitter's genus *Trimiopsis*. Dr. Sharp considers *Trimium* and *Trimiopsis* as hardly different.

T. DUBIUM, *Lec.* Deep yellow, very convex, nearly circular in transverse section, no pubescence visible. Surface, excepting the head, smooth and polished. Length, 1.00 mm. Plate XI., Fig. 95.

Head of the form of *parvulum*, except in the frontal margin being obtusely angulate; punctulate, no occipital impression; the foveæ large but not deep, the sulcus fine in some specimens, deeper in others, and slightly foveolate next to the

frontal tubercle; the vertex has in the middle, one-third of the length from the apex, a conspicuous circular tubercle; clypeus conical, this shape being brought about by the dilated antennal foveæ, leaving a narrow septum in connection with the overhanging frontal margin, (♀.) This septum in the ♂ is not contiguous with the apex of the frontal margin. *Antennæ* as in *parvulum;* the last palpal joint is more securiform and longer than in *parvulum.* *Prothorax* not wider than the head, length and width equal, the base less than one half wider than the neck; disk widest just before the middle, sinuate behind the small lateral foveæ; transverse sulcus nearly straight, the median angulation small. *Elytra* more convex from side to side than in *parvulum;* the sculpture is the same. *Abdomen* without visible basal carinæ, rather long, and produced behind in the ♀; the basal segment is not more than visibly longer than the second, the second ventral considerably shorter than the first. Legs long, rather slender.

Habitat. Southern States.

T. AMERICANUM, *Lec.* Deep yellow, very convex, impunctate; pubescence not perceptible. Length 0.6 mm.

Head narrower than the prothorax, tempora prominent, rounded, frontal margin arcuate, giving a triangular appearance to the head; corners rounded; occiput impressed; foveæ and circumambient sulcus deep. *Antennæ,* excluding the last joint, as long as the head; last joint of the palpi acuminate. *Prothorax* wider just before the middle, wider than long, evenly rounded from the neck to the transverse sulcus, lateral foveæ very small. *Elytra* convex, sides strongly arcuate, widest behind the middle, rather long, and rounded at the posterior lateral angle. *Abdomen* not visibly carinate at the base, the first dorsal segment longer than the second. Legs rather short.

Habitat. Southern States.

T. SIMPLEX, *Lec.* Darker, yellowish brown, prothorax red-brown, pubescence extremely fine and short. Form like that

of *americanum*, differing chiefly in the base of the head, which is not channelled or at most scarcely visibly impressed; the prothorax is at least as long as wide, much longer than in *americanum*, with conspicuous lateral foveæ. *Elytra* about the same as in *americanum*, seemingly not so convex from side to side. Length 0.5 mm.

Habitat. Southern States.

ACTIUM, *Casey*.

Body more robust than in *Trimium*, head smaller in proportion, the shoulders broader. The palpi are short, the last joint ovate, acuminate, thick. The elytra have three basal punctures and long, well impressed, discal lines; there is a subhumeral fovea in connection with a deeply impressed line on the declivous lateral part of the elytra, parallel to the marginal impressed line. The marginal line is also a constant mark in *Trimium*.

A. PALLIDUM, *Casey*. Slender, convex, yellow; pubescence very fine, recumbent, not conspicuous; body polished, impunctate. Length 1.2 mm. Plate XI, Fig. 99.

Head small, much narrower than the prothorax, as long as wide, eyes finely facetted, prominent, large; tempora shorter than the eye, not prominent, occiput impressed in the middle; there are two pubescent foveæ in the eye line, mutually twice as distant as either from the eye, connected by a wide, broadly arcuate channel. *Antennæ* short, one-half longer than the head, first and second joints subequal, larger; third to seventh subequal, becoming gradually shorter and more transverse; eighth to tenth transverse, equal in length, gradually wider; tenth three times as wide as long; eleventh wider, as long as the five preceding together, ovoid. *Prothorax* nearly as wide as long at one-third of its length from the neck, where the sides are evenly rounded and nearly straight to the basal angle; the base is arcuate and thinly margined; disk very convex, transverse sulcus deep, one-fourth from the base, angulated towards the base in the middle, connecting the large

pubescent lateral foveæ. *Elytra* together as wide as long, width at the shoulders greater than that of the prothorax; disk not very convex, trifoveate at the base, sutural and discal lines parallel, the latter abbreviated just before the middle. *Abdomen* shorter than the elytra, base with two short carinæ, segments subequal, the basal one longest. The abdomen in the ♂ is more rounded at the apex.

Habitat. Middle California.

There are four more species of this genus, one, *californicum Lec.* being insufficiently described. The three other species are described from unique specimens and may perhaps suffer a reduction in number at some future time. Taking *A. pallidum*, which is before me, as the type, they differ very little as follows:

A. POLITUM, *Casey*. Probably a ♀; abdomen longer, more pointed behind, and darker. Eyes small, tempora longer than the eye; antennæ with the tenth joint twice as wide as long; eleventh twice the width of the tenth, cylindrico-conical, as long as the five preceding. *Prothorax* as wide as long, feebly sinuate toward the base, the latter two-thirds as wide as the disk and one-half wider than the neck; elytral discal line reaching a little beyond the middle; abdominal carinæ one-third as long as the segment and one-fourth of the segmental width apart. Length 1.3 mm.

A CALIFORNICUM, *Lec.*, may be identical with *A. politum*, but the elytra are said to be sparsely punctulate.

A. ROBUSTULUM, *Casey*. ♂ tempora longer than the eye; tenth antennal joint twice as wide as long, eleventh elongate, acuminate, as long as the four preceding joints together. *Prothorax* sinuate at the base, wider than long; base four-fifths of the pronotal width and one-half wider than the neck; disk laterally depressed, anterior to the lateral foveæ; there is a trace of a median impressed line near the center; elytral discal line reaching beyond the middle; abdominal carinæ one-

third as long as the segment and separated by one-fourth of the width. Length 1.4 mm.

A. TESTACEUM, *Casey*. ♀ abdomen more pointed, head longer than in *A. robustulum*, elytral discal line one-half the length; abdominal basal carinæ one-third of the segmental length and separated by one-third of the width; otherwise like *A. robustulum*. Length 1.2 mm.

RHEXIDIUS, *Casey*. (Euplectus Lec.)

Head very transverse, frontal margin crenate, prothorax with linear grooves, antennæ straight, their insertion distant, posterior coxæ contiguous, tarsi with two unequal claws. Elytra with three abbreviated discal lines and a subhumeral fovea.

R. GRANULOSUS, *Casey*. Depressed, of the color of new leather, pubescence thin, short, coarse, the body granulated over the entire surface with minute tubercles. Length 1 mm. Plate XI, Fig. 100.

Head twice as wide as long; base slightly sinuate, occiput feebly impressed in the middle, tempora straight, convergent; eyes coarsely granulated, distant from the lateral margin of the vertex, frontal margin broadly arcuate and crenulated by fine longitudinal impressions; occipital foveæ far apart, near the tempora, connected by a fine arcuate sulcus parallel to the frontal margin. *Antennæ* slightly shorter than the head and prothorax together, first and second joints cylindrical, as long as wide; second smaller, more rounded; third to eighth narrower, transverse; eighth twice as wide as long; ninth and tenth gradually larger, transverse, trapeziform; eleventh as long as the five preceding together, scarcely wider than the tenth, conical from the middle of its length, base truncate. *Prothorax* widest in the middle, as wide as the head, sides nearly straight toward the base and the neck, arcuate in the middle; base arcuate, two-thirds as wide as the disk, and one-half wider than the neck; disk as wide as long, median sulcus

linear, fine, reaching the base, not the apex, and crossed by a straight, fine, linear sulcus, ending in a small, deep, pubescent, lateral fovea, less than one-fourth the length from the base. *Elytra* one-fifth longer than the prothorax, as long as the width across the low-hanging shoulders, and three-fourths as wide here as at the tip; disk depressed at the base, with four foveæ and three abbreviated discal lines, of which the middle one is longer, reaching the middle; the sutural lines are deep, slightly arcuate, sculptured; the discal tubercles are smaller than those on the head and prothorax. *Abdomen* slightly wider than the elytra, convex, more so posteriorly, borders strongly retuse, evenly arcuate toward the tip, transversely depressed in the middle third at the base between short obsolete carinæ, tubercles very minute. Legs slender; mesosternum bicarinate.

Habitat. Middle California.

R. CANALICULATUS, *Lec.* (Euplectus, *Lec.* Conoplectus, *Brend.*) Form compact, conoidal, tapering towards the head; pubescence fine, dense; surface polished, punctulate; color, pale brown. Length 1.2 mm. Plate XI, Fig. 101.

Head broader than long, eyes not prominent, tempora convergent, transverse, occiput canaliculate in the middle, convex above, foveæ small, very near the eyes; circumambient sulcus convergent for a short distance, thence parallel, connecting with the corresponding one by a broad transverse impression; frontal margin broad, divided by three fine, longitudinal, grooves into five low tuberculations, the external one,—supra-antennal—crossed by a short oblique cut; the median tuberculation (♂) bears a very small acute tubercle. Under surface behind the mentum densely pubescent with erect clubbed hair. *Antennæ* robust, one-half longer than the head, first and second joints sub-equal, cylindrical, as long as wide; third to eighth narrower, rounded, slightly transverse; ninth transverse, twice as wide as long; tenth transversely oval, twice as wide as the ninth, and one-half wider; eleventh ovate, slightly wider than the tenth, and as long as the two preced-

ing together. *Prothorax* one-third longer than the head, widest two-fifths from the base, where it is slightly wider than long, evenly and continuously arcuate to the base, and convergent and slightly arcuate toward the neck, which latter is half as wide, and the base four-fifths as wide as the width of the prothorax; sides minutely crenate posteriorly; disk very convex, imperceptibly and sparsely punctulate, with a narrow, linear, median sulcus, extending from the neck to the base, crossed by a similar, straight, linear, transverse sulcus, ending each side in a small, pubescent, fovea. *Elytra* from side to side very convex, longitudinally nearly straight; across the shoulders they are as wide as the prothorax, and equal to the length of the suture; across the tip they are one-fifth wider; shoulders rather prominent, sides nearly straight; sutural lines slightly arcuate, interval punctulate, base trifoveate, the two outer foveæ with shallow longitudinal impressions in the place of the discal lines, of which the outer ones are one-half longer than the inner ones, and may be traced to two-thirds of the elytral length from the base. *Abdomen* very convex, the segments sub-equal, border narrow, flat, the basal dorsal with two carinæ including less than one-fourth of the total width. Legs long, slender, tarsal claw with a fine hair-like appendage; anterior coxæ conical, pointed, posterior coxæ flat, transversely oval. Besides the transverse oval impression on the last ventral in the ♂, the acute tubercle of the frontal margin is prolonged backward so as to interrupt the transverse sulcus.

Habitat. East of the Mississippi River.

OROPUS, *Casey*.

O. STRIATUS, *Lec.* (*Trichonyx striatus Lec.*) Yellowish brown, uniformly colored; pubescence moderately dense and long, abundant; body sparsely punctulate. Length 2 mm. Plate XI, Fig. 102.

Head wider for one-half its length, eyes not prominent, large, not as long as the tempora, which latter are but slight-

ly arcuate, nearly transverse; base sinuate; occiput longitudinally impressed in the middle, much elevated on either side and abruptly declivous to the base; sides of the head very convergent from the posterior limit of the eye to the supra-antennal tubercle, the latter being rectangular outside, elevated; the angles are mutually distant about one-half the width of the head, frontal margin slightly convex anteriorly and depressed between the tubercles; vertex slightly convex and declivous to the front; foveæ small, mutually five times farther distant than either from the eye; circumambient sulcus broadly arcuate, deeper in front. *Antennæ* as long as the head and prothorax together, first joint as long as the eye, robust, impressed above; second, half as long, globular; third smallest; fourth to ninth increasing in width, but not in length; ninth and tenth gradually a little longer, trapezoidal, twice as wide as long; eleventh acuminate, ovoidal, truncate at the base, one-half longer than wide. *Palpi* with the second joint slender, third triangular, fourth fusiform, equal in length to the second and more than twice as thick. *Prothorax* a little wider than long, widest in the middle where the sides are evenly and strongly arcuate; in the middle third of the length they are nearly straight, convergent anteriorly and posteriorly, slightly sinuate near the neck and base; the base is arcuate, neck a little less than half of the pronotal width; disk roundly convex, punctulate, evenly pubescent, strongly punctured around the neck; lateral foveæ behind the middle third, deep, outside of them is a minute, black, sharp spine; transverse sulcus linear, nearly straight, the longitudinal sulcus crossing the transverse one, not quite reaching the base, widest one-fourth of the pronotal length from the neck, where it terminates abruptly. *Elytra* slightly longer, the width of the shoulders slightly narrower, and near the tip one-third wider than the width of the prothorax, punctulate, evenly pubescent, the hairs on the posterior third convergent to the end of the suture; disk convex, the declivous sides broad, with a longitudinal median carina; base of each elytron quadri-foveate, the outer one broader,

shallower, with its discal lines short; the other three foveæ are sharp and deep, the discal lines of the two middle ones nearly equal in length, reaching beyond the middle; sutural line deep, slightly arcuate, humeral tubercles strong, but not prominent. *Abdomen* narrower than the elytra, border broad, arcuately convergent; first segment one-fourth as long as wide, depressed at the base in the middle third; the fourth segment (♂) similar at the base to the first, with two lunate depressions, which meet in the middle. Mesosternum (♂) deeply impressed, anterior coxæ conical, contiguous, with a minute sharp tubercle on the exterior tip. Head punctured beneath, with a fine carina in the middle.

Habitat. California. (Alameda County.)

O. CONVEXUS, *Casey*. Form the same as in *striatus*. Length 1.9 mm.

Eyes their own length from the base. *Antennæ* with the first and second joints cylindrical, last joint as long as the five preceding ones. *Prothorax* as wide as long, base two-thirds of the width, longitudinal sulcus very slightly dilated near the middle. *Elytra* with the two middle lines equal, two-thirds of the elytral length.

Habitat. California. (Sonoma County.)

O. ABBREVIATUS, *Casey*, differs from *convexus* by the base of the prothorax being three-fourths of the pronotal width, the longitudinal sulcus fine, not dilated. *Elytra* with the middle lines unequal in length; the inner four-sevenths, the other three-sevenths of the elytral length. Length 1.9 mm.

The difference between these two is very slight. In *O. striatus* the length of the elytral lines vary, and the pronotal longitudinal sulcus does not always end so abruptly anteriorly. Repeated examination of many specimens prove to us beyond doubt the identity of *O. striatus*, *convexus* and *abbreviatus*.

O. MONTANUS, *Casey*. Form more slender, depressed. Length 1.8 mm.

The basal joints of the antennæ are smaller than in the other

species, third to eighth transverse, ninth and tenth twice as wide as long; eleventh three-fourths longer than wide. *Prothorax* widest in the middle, base two-thirds of the greatest width, sulcus fine, linear. *Elytral* lines, the second uniting with the sutural line one-third from the posterior elytral limits; the third is two-thirds, the fourth one-half of the elytral length.

Habitat. California. (Placer County.)

O. INTERRUPTUS, *Casey*. *Antennæ* as long as the head and prothorax together, third to eighth joints transverse and decreasing in length, ninth and tenth abruptly wider and longer, transverse; eleventh as long as the four preceding ones together. *Prothorax* widest one-third from the neck. *Elytral* lines, the middle ones close together, two-thirds of the elytral length, the external one one-third of the length. Length 1.9 mm.

Habitat. California. (Sonoma County.)

RHEXIUS, *Lec.*

(From ῥήγνυμι, *I break*, referring to the geniculate antennæ.)

Head and prothorax transverse; antennæ geniculate; tarsi with two equal claws.

R. INSCULPTUS, *Lec.* Pale brown, body depressed, pubescence abundant, erect. Palpi small, last joint thick, ovate. Length 1.2 mm. Plate XI., Fig. 103.

Head transverse, punctate, twice as wide as long, sides parallel to the middle, thence strongly convergent; frontal margin one-half of the width across the roundly angulated tempora; antennal tubercles very prominent; just behind them is a small oblong fovea, the space between them concave; the base is emarginate, the occiput carinate, the neck slender, one-fourth the width of the head; eyes prominent. *Antennæ* as long as the head and prothorax together, first joint cylindrical, as long as the frontal margin, and one-third as thick; second as long as thick, not thicker than the first, obconical; third to

eighth equal, transverse, seventh, eighth and ninth gradually wider; ninth as wide as the second, and twice as wide as the third; tenth of the same form larger both ways; eleventh conical-ovate, slightly wider and truncate at the base, as long as the two preceding ones. *Prothorax* widest on the anterior third, as wide as the head, anterior, edge broadly arcuate, transverse, base not quite three times wider than the neck; sides, with the base, forming a broad arch, nearly semicircular; the sides bear three recurved spines, the disk is depressed-convex, with a linear median sulcus crossing a transverse linear one, which ends at the sides in a longitudinal arcuate depression, with a small round fovea. *Elytra* as wide across the high, spinous, prominent shoulders as the suture is long; in the middle they are slightly broader, sides slightly arcuate, depressed, impunctate, disk narrowly elevated; sutural lines straight, well impressed, discal lines deep at the basal fovea, evanescent before the middle; from the humeral spine to the tip, near the lateral margin, is a sub-marginal sharp ridge. *Abdomen* strongly margined, convex, tumid in the middle, first segment depressed at the base with two short carinæ one-fourth of the total width apart. Legs rather short. ♀ second tarsal joint dilated, the ventral segments longitudinally concave, the last ventral transverse; at the tip is a deep funnel-shaped fovea situated in a lunately depressed area.

Habitat. East of the Mississippi River from north to south.

R. SUBSTRIATUS, *Lec.* Brown, less convex than *R. insculptus.*

Head of the same form and sculpture as in the preceding species. *Prothorax* with a longitudinal linear sulcus and three large impressions near the base. *Elytra* with the basal margin elevated (as in *R. insculptus*), basal fovea deep, each elytron with four faint striæ, of which the sub-sutural one is longer and more distinct, the others extending only about to the middle. Antennæ with the ninth and tenth joints less suddenly larger than in *R. insculptus.* Length 1.2 mm.

Habitat. Florida.

THESIUM, *Casey*.

(*Apothinus* Sharp (?)).

Form comparatively short and broad, depressed, the eyes large, the disk of the vertex narrowed on the frontal margin; the antennal joints from the sixth upward gradually wider; prothorax much wider than the head, widest before the middle, and sinuate toward the base, the lateral margin crenate; elytral disk broad, nearly quadrate; abdomen broad, margin broadly retuse, the fourth segment not prolonged; the prosternum is carinate.

T. CAVIFRONS, *Lec.* Color uniform reddish-brown or darker, legs, antennæ, and palpi, paler. Pubescence pale, abundant. Length 0.8 mm. Plate XI., Fig. 104.

Head small, broader than long, eyes large, coarsely facetted, behind the middle, therefore, the tempora are short, nearly transverse; occiput convex, not impressed, and, in a line behind the eyes, twice as wide as the frontal margin; vertex abruptly elevated above the eyes, with two small pubescent foveæ in a line through the middle of the eyes, connected by a broadly impressed sulcus, parallel to the lateral margin of the disk, shallow near the fovea and very deep behind the frontal margin; the surface between the foveæ has an impressed puncture in the center. Supra-antennal tumefactions strong, externally angulated, the frontal connecting ridge fine and sharp; clypeus and labrum prominent, the latter very broad, with the anterior margin straight, and narrowed at its base. Antennæ as long as the head and prothorax together, first and second joints sub-cylindrical, equal in width; third to fifth gradually smaller, obconical; sixth to ninth sub-equal in length, rapidly increasing in width; the ninth two and one-half times wider than long; tenth nearly as long as the two preceding together and twice as wide as long; the last, large, ovate, truncate at its base, as long as the three preceding joints together, The last palpal joint is rather long, of the same form as the last antennal joint. *Prothorax* widest just before the middle where it is

one-fifth wider than the head with the eyes included; the sides are strongly arcuate, slightly sinuate anteriorly toward the neck, strongly sinuate posteriorly to the base and crenate; the base is twice as broad as the neck; the disk broadly convex, polished, indefinitely and imperceptibly punctulate; near the anterior margin is a comma-shaped longitudinal fovea with its attenuated end not reaching one-third of the pronotal length; one-third the length from the base is a deeply impressed, slightly arcuate groove, connecting the lateral, pubescent, rather irregularly shaped foveæ with the triangular median impression; the slightly elevated space between the transverse sulcus and the thinly elevated basal margin has on each side of the middle a small rounded impression (or perhaps a tubercle), and, near the basal angle, a deep puncture. *Elytra* as wide across the rather prominent shoulders as the prothorax, the sides evenly arcuately divergent; the length of the suture is equal to the width of the shoulders, the sutural lines are nearly parallel, fine, and close, the lateral one-half of the elytral length, fairly conspicuous; the base of the elytra is slightly elevated, the basal impression transversely dilated. *Abdomen* short and broad, sides of the three upper segments parallel, the four segments sub-equal in length; the base of the first segment has three transverse depressions, of which the middle one is twice as wide as the lateral one. Legs slender, weak. The sexual differences are not very prominent, consisting of the rounded form (♂) of the last ventral which is broader than in the ♀, and the transverse impression on the penultimate ventral segment.

Habitat. Mississippi Valley.

T. LATICOLLE, *Casey*. Variety of the preceding; darker in color, nearly piceous-black, the elytra in some reddish, in others greenish brown, legs and antennæ paler. The prothorax is more strongly sinuate at the sides near the base and the median oblong fovea is shorter, being in some a mere comma-shaped puncture.

Habitat. Louisiana. Iowa.

TRIMIOPLECTUS, *Brendel.*

TABLE OF THE SPECIES OF TRIMIOPLECTUS.

Prothorax narrowing toward the base, to the width of the rather thick neck.
- Vertex with the sulcus wanting or but faintly indicated; occipital foveæ small, isolated. - - - - *obsoletus* n. sp.
- Vertex with deep foveæ connected by a deep, arcuate, sulcus. - - - - - - - - - - - - - - *arcuatus.*

Prothorax slightly narrowed toward the base.
- Prothorax transverse, sides parallel in the middle; posterior angles broadly rounded; head as wide as the prothorax. - *ruficeps.*
- Prothorax wider than long, sides convergent posteriorly; basal foveæ smaller, and connected by a conspicuous sulcus. Head very much narrower than the prothorax - *capitulum.*

T. OBSOLETUS, n. sp. Yellow, pubescence fine, sparse; surface impunctate or with obsolete punctures visible only under a magnifying power exceeding sixty diameters; body convex. Length 1.2 mm. Plate XI., Fig. 105. Plate XII., Fig. 123.

Head, including the mouth, forming an equilateral triangle with arcuate corners; vertex flat, with two round foveæ in a line before the middle of the eye, the latter situated far down on the sides; frontal margin straight with an obsolete transversely impressed line between the small antennal tubercles, not connected with the foveæ; occiput sinuate. *Antennæ* twice as long as the head, first and second joints thicker, cylindrical; ninth transversely oval, as wide as the second; the tenth larger, one-third wider than long; last joint twice as wide as the tenth and as long as the three preceding together. *Prothorax* very convex, very little longer than wide, sides arcuate to the lateral foveæ, thence straight to the base; the transverse sulcus is one-fourth from the base, deep, straight, connected with a triangular impression in the middle. *Elytra* convex, sutural lines straight, recurrent at the base, discal lines recurrent for half the length, no intermediate basal punctures. *Abdomen* convex, border moderate, basal dorsal segment longer than any of the others; at the base is a transverse, pubescent, linear, depression including one-half of the seg-

mental width; fourth dorsal not prolonged. The first and second ventrals longer, the second half as long as the first. ♂ anterior thighs strongly clavate, last ventral transversely impressed, otherwise like the ♀.

Habitat. Cedar Rapids, Ia. One pair sifted from rotten wood in September.

T. ARCUATUS, *Lec.* Yellowish brown, highly polished, impunctate; legs and antennæ pale; pubesence inconspicuous. Length 1.2 mm.

Head slightly wider than long, tempora parallel, angles rounded, eyes small; vertex impunctate, with two small pubescent foveæ between the eyes, mutually twice as distant as either from the eye; sulcus feeble, wider and somewhat deeper behind the frontal ridge; supra-antennal tubercles obliquely oblong crossed by a short impressed line; labrum emarginate anteriorly, with a transverse row of setæ. *Antennæ* one-half longer than the head, funicle moniliform, ninth and tenth joints gradually wider, transverse, eleventh as long as the four preceding together, one-half longer than wide, conical, acuminate. The last joint of the maxillary palpi is fusiform, twice as long as thick. *Prothorax* widest across the middle, as wide as the head and imperceptibly longer, sides evenly and strongly arcuate anteriorly, and very slightly sinuate toward the base; the neck is nearly as wide as the base; disk very convex, basal foveæ one-fourth from the base, nude, the middle one punctiform, the lateral ones large, connected by an arcuate line. *Elytra* slightly wider across the shoulders than the pronotum, length one-third greater than the width of the shoulders; sides strongly arcuate; disk convex, sutural lines arcuate, discal lines deep, one-third of the elytral length. *Abdomen* convex, wider across the third segment than at the base, the first segment longer; no carinæ. Legs long, tarsi slender, the second joint twice as long as the last. The under surface of the head, behind the mentum, is hairy, each hair ending in a small globule. The metasternum has a deep fovea near the middle. ♂, intermediate femora thicker.

Habitat. Middle and Southern States.

The length and width of the prothorax in this species is very deceptive; seemingly it is longer than wide but drawing and measuring prove the dimensions to be nearly equal.

T. RUFICEPS, *Lec.* (*T. integer*, Lec.) Dark brown, elytra darker; surface polished, impunctate, pubescence short and fine. Length 0.7 mm.

Head large, longer than wide, occipital foveæ mutually as far distant as either from the eye, connecting sulcus arcuate anteriorly. *Antennæ* short, not one-third longer than the head, the last joint as long as the five preceding, acuminate at the apex. *Prothorax* as wide as the head, slightly wider than long, anterior and posterior limits arcuate, angles broadly rounded; the sides are parallel in the middle, disk moderately convex; near the base, in the middle, are two large, pubescent, circular, foveæ, separated by a short, longitudinal, carina; on the sides, near the middle of the length, is an equally large pubescent fovea; transverse sulcus interrupted. *Elytra* slightly wider across the shoulders than the head, sides nearly parallel, feebly arcuate near the posterior limits; suture one-fourth longer than the base is wide, and one-half longer than the pronotum; disk polished, sutural lines deep, slightly arcuate, two elongated impressions near the base, of which the outer one is the larger. *Abdomen* without carinæ, narrower than the elytra at the base. Legs slender, tarsi short, somewhat thicker in the middle, claws minute.

Habitat. Michigan, Illinois, Texas, Florida.

T. CAPITULUM, *Casey.* Red throughout, pubescence fine, short, close. Length 1.5 mm.

Head small, as wide as long, tempora acutely rounded, much smaller than the large eyes, occiput sinuate, vertex polished, impunctate; in the eye line are two circular, pubescent, foveæ, connected by a parabolic, equally deep, sulcus, the enclosed surface convex; supra-antennal tubercles elongate, prominent, the frontal margin broad, depressed in the middle. Antennæ short, not more than one-third longer than the head,

slender, third to seventh joints moniliform; eighth to tenth gradually wider, equal in length; tenth twice as wide as long; eleventh much wider, a little longer than wide, truncate at the base, ovate, obtuse. Maxillary palpi with the last joint nearly twice as long as wide. Space behind the mentum hairy. *Prothorax* widest at the middle, length and width equal, wider than the head; sides, anteriorly, strongly arcuate toward the neck, convergent and perceptibly sinuate to the base; the neck is about three-fifths as wide as the base; disk very convex, impunctate, sulcus narrow in the middle where it touches a deep oblong fovea, nearly reaching the base, and connecting with the deep lateral pubescent foveæ. *Elytra*, across the prominent shoulders, slightly wider than the prothorax, the length being about one-half greater; very convex, impunctate; sutural lines close together, nearly straight, the discal lines narrow, more than one-half as long as the elytra. *Abdomen* narrower than the elytra, convex, impunctate, sides anteriorly parallel, with two short carinæ at the base; the three basal segments are gradually shorter. Legs long. On each side of the anterior limit of the metasternum is a transverse, pubescent, fovea; prosternal fovea large, transverse. ♂, intermediate femora enlarged, lunate; antennal club more robust.

Habitat. Florida.

EUPLECTUS, *Leach*.

TABLE OF THE SPECIES OF EUPLECTUS.

1^2 Pronotum without longitudinal sulcus.

2^2 Abdominal dorsals not carinate.

Head longer than wide, last antennal joint acuminate. Length 1.6 mm. - - - - - - - - - *leviceps*.

2^1 Two dorsals carinate.

3^2 Pronotal foveæ connected by a transverse sulcus.

Head wider than long; terminal antennal joint elongate, acuminate. Length 1.6 mm. - - - - - - - *crinitus*.

Head longer than wide, the terminal antennal joint obtuse-ovate, penultimate joints sharp-edged disks. Length 1.4 mm. - - - - - - - - - - - - *decorus*.

3^1 Pronotal foveæ very large, not connected, the longitudinal sulcus indicated by an excessively fine line. Length 1.4 mm. - *cavicollis.*

1^1 Pronotum longitudinally impressed in the middle.

4^2 Head narrower than the prothorax.

5^2 First dorsal segment without carinæ; elytral discal lines short; sculpture of the head feeble. - - - - - - - - *debilis.*

5^1 Two dorsal segments with short carinæ.

6^2 Elytra convex, sutural lines deeply impressed.

Elytral discal lines one-half of the length of the elytron; impressions on head and prothorax very deep. - *fossulatus.*

Elytral discal lines short, impressions on head and prothorax not deep. - - - - . - - - - - *pumilus.*

6^1 Elytra depressed, plane, sutural and discal lines sharp, fine, and long. - - - - - - . - - - - - - *planipennis.*

4^2 Head as wide as the prothorax; shoulders wider than head or prothorax.

7^2 Occiput sinuate, sides of the pronotum broadly, evenly, arcuate; sides of elytra nearly straight, divergent.

8^2 Occipital foveæ large, nearer together, sulcus deep. - *rotundicollis.*

8^1 Occipital foveæ smaller, farther apart, ♂ with two spines emerging from under the third ventral segment.

Pubescence inconspicuous. Length 1.3 mm. - - *spinifer.*

Pubescence coarse, erect. Length 1.6 mm. - - *sexualis.*

7^1 Occiput convex, not sinuate; sides of pronotum sinuate behind the middle; sides of elytra arcuate. - - - - - - *interruptus.*

4^1 Head wider than the prothorax.

9^2 Prothorax longer than wide. - - - - - - - *longicollis.*

9^1 Prothorax not longer than wide.

10^2 Shoulders slightly wider than the head, prothorax narrower.

Prothorax wider than long, base of abdomen as wide as the elytra. - - - - - - - - - - *difficilis.*

Prothorax as wide as long, base of abdomen narrower than the elytra. - - - - - - - - - - *congener.*

10^1 Shoulders as wide as the head, sides of elytra parallel; form linear, depressed.

11^2 Pronotum with a fusiform median canaliculation.

Occipital foveæ widely separated; head not punctured. Length 1.6 mm. - - - - - - - - - - *linearis.*

Occipital foveæ nearer together; head strongly punctured. Length 1.5 mm. - - - - - - - *confluens.*

11^1 Pronotum with a small, elongate, median puncture.

Occipital foveæ near together, head strongly punctured. Length 1.3 mm. - - - - - - - - - *californicus.*

Occipital foveæ three times farther apart than either from the eye; head impunctate. Length 1.6 mm. - *longissimus.*

Occipital foveæ very near together. Length 0.95 mm. - *pertenuis.*

E. LEVICEPS, *Casey*. Brown, legs, antennæ, and palpi yellowish red; pubescence short, conspicuous. Length 1 mm.

Head small, as long as wide, eyes large, tempora not longer than the eyes; vertex impunctate, occipital foveæ small, pubescent, mutually not more distant than either from the eye, and connected by a parabolic, feebly impressed sulcus, frontal margin depressed, with the lateral tubercles rounded, prominent. *Antennæ* one-half longer than the head, slender, the club robust, slightly wider than the eighth; eighth, ninth and tenth equal in length; tenth twice as wide as the eighth; eleventh a little wider than the tenth and as long as the four preceding together. *Prothorax* slightly wider than the head, widest one-third the length from the neck, arcuate toward the neck, very feebly sinuate to the base, not quite as long as wide; disk convex, polished, indistinctly, minutely, punctulate; base three-fourths as wide as the prothorax, with a well defined, transverse, sulcus one-third from the posterior limit, triangularly dilated in the middle, connecting the lateral, rounded, pubescent foveæ; the median dilatation is connected with the base by a distinctly visible carina. *Elytra* slightly wider than the prothorax, slightly longer than wide, sides arcuate, disk somewhat depressed, impunctate; shoulders prominent, the sutural lines slightly arcuate, discal lines scarcely indicated. *Abdomen*, above impunctate, beneath finely punctulate, the dorsal base not carinate; metasternum ciliate behind, in the middle with yellow hair. Legs long.

Habitat. Maryland.

E. CRINITUS, *Brend*. Brown, punctulate; pubescence very dense, giving an opaque aspect to the surface. Length 1.6 mm. Plate XI., Fig. 106. Plate XII., Fig. 123.

Head broader than long, eyes moderately prominent, large, tempora as long as the eye, slightly arcuate, convergent; occiput sinuate, with a deep indentation in the middle, sides convergent before the eyes, supra-antennal tubercles very prominent; frontal margin anteriorly convex, or obtusely angulate, frontal impression between the antennal tubercles shal-

low; occipital foveæ near the middle of the length, and mutually twice as distant as either from the eye; sulcus obsolete near the frontal tubercle, the middle part of the vertex very convex. *Antennæ* as long as the head and prothorax together, the two basal joints stouter; seventh and eighth slightly larger than the preceding; ninth and tenth increasing in length and twice as wide as long; eleventh slightly wider than the tenth, twice as wide as long, and equal in length to the three preceding joints, ovate, acuminate. *Prothorax* slightly wider than long, slightly wider than the head, widest before the middle, broadly arcuate to the neck, sinuate behind, base three-fourths of the greatest width; disk convex, transverse sulcus deep, posteriorly angulate in the middle, where it is deeper; lateral foveæ small, pubescent. *Elytra*, across the prominent shoulders, slightly wider than the prothorax, suture one-half longer than the prothorax; sides slightly arcuate, depressed, sutural lines arcuate, discal ones one-third the length, wide at the base; intermediate basal puncture very small. *Abdominal* segments widest at the base, diminishing in width, the three basal ones each with two carinæ.

Habitat. Northern States.

E. DECORUS, *Casey*. Reddish brown, elytra, legs, and antennæ, yellowish red, polished, translucent; pubescence short, fine, inconspicuous. Length 1.4 mm.

Head large, slightly longer than wide, tempora as long as the large eyes, slightly arcuate, convergent, frontal margin arcuate anteriorly, depresssed in the middle, supra-antennal tubercles large, rounded, prominent; vertex flat above, declivous on the sides, elevated far above the eyes, sparsely punctulate; there are two pubescent, circular, foveæ in a line with the posterior margin of the eyes, mutually one-half more distant than either from the eye; sulcus very convergent, thin, and obsolete anteriorly. *Antennæ* very short, slightly longer than the head, second joint sub-globular, thicker than the first; the other joints transverse; the tenth more than four times wider than long, lenticular; the last as long as the four pre-

ceding together, ovoid, obtuse at the apex, and very hairy. *Prothorax* widest in the middle, slightly wider than the head and one-fourth wider than long, sides, anteriorly, arcuately convergent, less so posteriorly, and feebly sinuate; disk moderately convex, evenly punctulate, with a nearly straight, deeply impressed sulcus one-fifth of the length from the base, connecting the round, pubescent, lateral foveæ with the nude puncture of the middle. *Elytra* nearly quadrate, the sides evenly arcuate, a little wider across the shoulders than the prothorax; disk closely punctulate, convex, darker at the base and tip, sutural lines straight, fine; base with two punctures; from the external one emerges an ill-defined line, arcuate externally, and converging toward the suture; one-fifth of the length from the tip it becomes obsolete. *Abdomen* with the sides nearly parallel, convex, closely punctulate, the first two dorsals each with short, divergent, widely distant carinæ. Legs long. Last palpal joint large, conical.

Habitat. Texas.

E. CAVICOLLIS, *Lec.* Reddish brown, abdomen paler, elytra, legs, and antennæ, red; surface polished, punctate, pubescence coarse, conspicuous. Length 1.4 mm.

Head large, slightly wider than long; eyes large, tempora slightly arcuate, very convergent; occipital foveæ wanting, the circumambient sulcus deep, straight, convergent, arcuate behind the frontal margin, the enclosed surface very convex; occiput punctate at the sides, carinate at the middle, antennal tubercles strong, angulated. *Antennæ* robust, as long as the head and prothorax together; third to eighth joints moniliform; ninth slightly transverse; tenth twice as wide as long, not longer than the ninth; the last is as long as the three preceding together, slightly longer than wide. *Prothorax* widest at about one-third the length from the neck, slightly wider than the head, and wider than long; sides arcuately convergent, strongly sinuate anteriorly, nearly straight and less convergent posteriorly; neck about two-thirds as wide as the base; disk punctulate, the punctures deep and far

apart; the median longitudinal impresssed line is obsoletely indicated, and, near the base, is a very large, nude, transverse, fovea; lateral impressions deep, irregular, no transverse sulcus. *Elytra*, across the large, prominent, shoulders, a little wider than the prothorax, sides arcuate, nearly parallel; disk one-half longer than the prothorax, punctured in rows near the suture; sutural lines strong, straight, the basal punctures deep, the outer two nearly behind one another; discal lines short, obsolete. *Abdomen* at the base, slightly narrower than the elytra, the first three segments increasing in width, impunctate, strongly margined; first two segments with two distant, divergent, basal carinæ. Legs short and strong, tarsi stronger in the distal half, and with a long curved claw.

Habitat. Florida.

E. DEBILIS, *Lec.* Slender, light brown or darker, elytra darker, pubescence short. Length 0.8 mm.

Head small, wider than long; eyes small, convex; tempora small, acutely rounded, shorter than the eye; base very slightly sinuate, not impressed in in the middle, vertex impunctate, sides declivous; foveæ mutually as distant as either from the eye, deep, connected by a parabolic, slightly impressed, very narrow sulcus or line; frontal margin convex, feeble; supra-antennal tubercles small, angulate, not prominent. *Antennæ* two-thirds longer than the head, eighth to tenth joints gradually and uniformly wider, sub-equal in length, last joint ovate. *Prothorax* widest just before the middle, as wide as long, slightly wider than the head, nearly straight posteriorly, base two-thirds and neck one-half as wide as the prothorax; disk strongly convex, median sulcus fusiform; one-fourth from the base is a transverse, narrow sulcus, angulated in the middle, and terminating in two large, lateral foveæ. *Elytra*, across the shoulders, distinctly wider than the pronotum, longer than wide, sutural line deep, discal line rudimentary. *Abdomen* narrower than the elytra, basal half with the sides parallel, no basal carinæ. Legs short, slender. Habitat. Florida.

E. FOSSULATUS, *Brend.* Dark brown, polished, sparsely pubescent. Length 1 mm. Plate XII., Fig. 124.

Head wider than long, or, excluding the eyes, as wide as long; eyes prominent, tempora nearly straight, convergent toward the base, neck as wide as the front; sides anteriorly, very slightly sinuate, convergent to the supra-antennal tubercles; frontal space between the tubercles depressed; frontal margin, a thin, convex ridge; disk uneven, the impression very deep, the foveæ circular, mutually as far apart as either from the eye; the grooves are wide, parallel, ending in the large frontal depression; intervening space high, convex between the foveæ. *Antennæ* from the first to the tenth joint, as long as the head; first and second joints respectively as large as the tenth and ninth, intervening joints equal, transverse, very small, eleventh ovoid-acuminate, half as wide as the entire front. *Prothorax* wider than the head and wider than long, sides slightly sinuate near the large lateral foveæ, disk minutely punctulate; median sulcus fusiform, nearly reaching the large, triangular fovea, which is connected with the lateral ones by a nearly straight, transverse sulcus about one-third of the pronotal length. *Elytra*, with high and prominent shoulders, the humeral width equal to the length of the suture and slightly greater than that of the prothorax; sutural lines very deep; three basal punctures; discal lines half the length, deep, and broadly impressed near the humeri. *Abdomen* longer than the elytra, the first and second segments with minute carinæ.

Habitat. Illinois. (Peoria). Differs from *E. pumilus* in the deep sculpture of the head and in the long discal lines of the elytra.

E. PUMILUS, *Lec.* Yellowish brown, pubescence thin, fine and short. Length 0.7 mm.

Head small; eyes large, prominent; tempora as long as the eye, not prominent, interocular surface rough, abruptly elevated far above the eyes, nearly flat above, narrower anteriorly; base sinuate, occipital foveæ minute, mutually one-half more distant than either from the eye and connected by a slightly impressed

parabolic sulcus; antennal tubercles small, prominent. *Antennæ* not much longer than the head, slender, ninth joint as long as the tenth and twice as wide; tenth one-third wider than the eleventh; the last joint is much wider, as long as the four preceding together, elongate, ovate-acuminate. *Prothorax* widest before the middle, a little wider than the head and slightly wider than long; base two-thirds of the pronotal width, the neck one-half of that measure; disk convex, granular, with a deep, median, fusiform sulcus, transverse sulcus one-third from the base, but slightly dilated in the middle, connecting the large, pubescent, lateral foveæ. *Elytra*, at the shoulders, wider than the pronotum, sides arcuate, disk quadrate, convex, impunctate, shining, discal lines short, not conspicuous. *Abdomen* narrower than the elytra, impunctate, shining convex, the first two dorsal segments with two short, distant, carinæ. Legs short and slender.

Habitat. Louisiana, Georgia.

E. PLANIPENNIS, *Brend.* Piceous brown, abdomen and prothorax paler; much depressed, densely pubescent with fine, appressed hair. Length 1.25 mm. Plate XII., Fig. 118.

Head triangular, anteriorly truncate, posterior angles strongly arcuate, eyes very prominent, as long as the tempora, base entire, across the posterior angles twice as wide as the straight frontal margin; frontal tubercles small, space between them and behind the frontal margin deeply concave, occipital foveæ large and connected with the frontal excavation by a very short sulcus, leaving in the middle of the vertex a short, acute, triangular elevation, posteriorly continuous with the occiput. *Antennæ* one-half longer than the head, joints one and two nearly equal, rounded, longer than wide, third to eighth very transverse, equal, narrower than the second, ninth one-third wider, tenth twice as long and wide as the ninth; last joint ovate, truncate at the base, one-third longer than wide, slightly wider than the tenth, pubescence denser at the tip. *Palpi* short, yellow. *Prothorax* very broadly convex, nearly plane, punctulate, sides evenly rounded with the basal

angles, broadly arcuate, as long as the width of the head, the prominent eyes included, and less than one-fourth wider; disk nearly flat in the middle, an oblong fovea before the middle and large lateral fovea just behind the middle, connected by a fine, straight sulcus, running through a very small median fovea. *Elytra* one-half longer, across the high shoulders slightly wider, across the tip one-fourth wider than the prothorax, sides behind the middle nearly parallel; disk flat, depressed, with declivous sides and tip, very densely pubescent, discal lines two-thirds of the length, very sharp and fine, sutural lines the same and entire; basal punctures three. *Abdomen* with the first and second dorsals bicarinate in the middle, carinæ including one-fourth of the segmental width. Legs short, yellow. ♂ with the last ventral nearly circular and an inconspicuous transverse impression at the base of the penultimate segment.

Habitat. Linn County, Iowa.

Very distinct by the small head and the form and sculpture of the prothorax.

E. ROTUNDICOLLIS, *Brend.* Piceous brown throughout, legs paler, pubescence fine, not dense; stature robust, compact. Length 1.33 mm. Plate XI., Fig. 113. Plate XII., Fig. 116.

Head narrower than the prothorax, one-fifth wider than long, tempora prominent, angulate with the base, nearly parallel behind the moderately prominent eyes; frontal margin two-thirds as wide as the base, which latter is emarginate and visibly impressed in the middle of the occiput; the outlines of the head resemble those of *E. confluens;* occipital foveæ large, in a line with the posterior margin of the eyes, circumambient sulcus deep, parallel to the sides of the head, the frontal part transverse, deeper; frontal margin thin and straight. *Antennæ* rather long, reaching the transverse thoracic sulcus; first and second joints larger, oblong; third to sixth equal, globular, small; seventh to tenth gradually increasing in length and width, transverse; tenth four times wider, and twice as long as the seventh, the last ovate, truncate at the base, wider than the tenth, one-half

longer, and as long as the three preceding ones; pubescence long. *Prothorax* transverse, oval, evenly rounded, as long as the width of the head behind the eyes, and one-fifth wider than long, convex; discal fovea, or abbreviated sulcus, less than one-fourth of the length of the prothorax, situated just before the middle; transverse sulcus one-fourth from the base, deep, doubly arcuate, deeper in the middle, ending in a large lateral fovea, the enclosed basal space granulated. *Elytra* moderately convex, just visibly broader than the prothorax across the high, narrow shoulders; the length of the suture is one-half more than that of the prothorax; basal foveæ deep, sutural lines parallel, discal lines dilated towards the shoulders, reaching one-third from the base; sides divergent, somewhat arcuate behind the middle. *Abdomen* narrower than the elytra, broadly margined, with extremely short carinæ on the bases of the first and second segments and a mere indication of them on the third. Legs rather strong and moderately short. ♂, fourth ventral with a fine, transverse line at the posterior margin, laterally hooked; the base of the fifth is transversely depressed in the middle third, and bears a transverse linear impression behind the middle; last ventral finely punctured, not carinate.

Habitat. Linn County, Iowa.

E. SPINIFER, *Casey*. Brown, impunctate, polished, pubescence inconspicuous. Length 1.2 mm. Plate XI., Fig. 111. Plate XII., Fig. 117.

Head large, and, excluding the eyes, as long as wide, somewhat quadrate, sides slightly divergent, eyes moderately prominent, tempora prominent, arcuately divergent, longer than the eye; base sinuate, with a median occipital impression; occipital foveæ pubescent, moderately large, mutually two-thirds more distant than either from the eye, and connected by a parabolic sulcus, which is deeper behind the arcuate frontal ridge; the enclosed surface is very convex; supra-antennal tubercles strong, transversely and obliquely oblong. *Antennæ* one-half longer than the head, robust, the first two joints stout; the joints of the

funicle half as wide, transverse, ninth and tenth longer and wider, transversely oval; eleventh larger, little longer than wide, annulated, acuminate. Last joint of the maxillary palpi short, conical. *Prothorax* as wide as the head, widest on the anterior third, about one-sixth wider than long, sides arcuate throughout, more so anteriorly, base continuously and slightly arcuate with the sides, neck one-half as wide as the pronotal width and two-thirds as wide as the base; disk slightly convex, with an oblong fovea before the middle, and one-third from the base, is a deep, angulated, sulcus connecting the large, pubescent, foveæ. *Elytra*, across the high shoulders, as wide as the prothorax, sides slightly and arcuately divergent, the disk nearly quadrate, not very convex; the sutural lines are close, nearly parallel, discal lines half the elytral length, emerging from the outer basal foveæ, which are large and pubescent; a third intermediate basal puncture is also present. *Abdomen* narrower at the base than the elytra, wider across the third segment, the first two basal segments with short divergent carinæ. Legs strong, the tibiæ of the male dilated on the discal half. The third ventral in the male is sinuate in the middle, tumefied at the sides of the posterior limit; beyond this, on each side, is a long, externally arcuate spine, contiguous to the fourth segment, which is transversely impressed at the base; the fifth ventral has a transverse impression in the middle; last segment punctate and with a median carina.

Habitat. Illinois, Louisiana, Georgia.

E. SEXUALIS, *Casey*. Brown, legs paler, pubescence thin, very long, erect, coarse; surface polished, with a few feeble, minute, punctures. The general form is that of *E. spinifer*. Length 1.6 mm.

Head large, little broader than long, eyes large, moderately prominent, tempora as long as the eye, not prominent, convergent; base strongly sinuate, the pubescent foveæ three-fourths more distant than either from the eye, connected by a deep, parabolic sulcus passing from the tempora through the foveæ to the front, where it is wider and deeper; intermediate

space very convex, supra-antennal tubercles very large, angulate externally; frontal ridge strong, feebly notched in the middle; labrum with the lateral angles acute, transverse. *Antennæ* as long as the head and prothorax together, formed like those of *E. spinifer*. *Elytra*, across the high shoulders slightly wider than the prothorax, sides more arcuate, disk more convex, more nearly quadrate compared with *E. spinifer*. *Abdomen* as wide as the elytra, sides straight, parallel, carinæ on the two basal segments more distant, parallel, and three-fourths as long as the segment. Legs slender and rather long. The ♂ characters resemble very much those of *E. spinifer*, except that the fourth and fifth segments are emarginate posteriorly for their entire width.

Habitat. South Carolina, Georgia.

E. INTERRUPTUS, *Lec.* Form more robust, shoulders broader, pubescence not dense. Color, rust red. Length 1.4 to 1.6 mm. Plate XI., Fig. 108. Plate XII., Fig. 122.

Head large, eyes large, tempora as long as the eye, arcuately convergent, occiput not sinuate nor impressed, frontal margin straight, sharp, foveæ large, in a line with the middle of the eye, connecting sulcus deep, parallel to the sides, broader and arcuate behind the frontal margin, inclosed space very convex, smooth. Sides, external to the sulcus, somewhat punctured, lateral frontal tubercles strong. *Antennæ* not quite as long the head and prothorax together, first joint larger than the second; third to eighth joints much narrower than the second, equal in width, gradually more transverse; ninth longer, nearly twice as wide, obconical, truncate at the base; tenth of the same form, larger; eleventh slightly wider than long, annulate near the acute apex. *Prothorax* widest before the middle, where it is arcuately rounded, and slightly sinuate anteriorly, sides, toward the base, nearly straight, convergent; near the lateral foveæ they are imperceptibly sinuate; the basal angles are rounded; disk convex, minutely punctulate, with a small central fovea; basal sulcus one-fourth from the base, deeply arcuate, lateral foveæ large and deep.

Elytra minutely and sparsely punctulate, rather convex, as wide across the shoulders as the prothorax, and nearly one-third wider across the middle; the length of the suture is one-fifth greater than the width of the prothorax, the sides evenly arcuate; the sutural interval is slightly dilated behind the middle, the lines deep, discal ones half the length of the elytra. *Abdomen* as long as the elytra, border strong, basal carinæ including one-fifth of the segmental width, very short on the first and second segments and only indicated on the third. Legs moderately strong. Sexual differences consist of a lateral swelling of the posterior edge of the third ventral segment, a transverse median depression of the base of the fourth, and a transverse median depression before the middle of the fifth; the last ventral is lozenge-shaped, longitudinally carinate in the middle and punctured.

Habitat. Florida, Virginia, Louisiana, Iowa.

E. LONGICOLLIS, *Casey*. Pale brown, pubescence dense and fine. Length 1.3 mm.

Head as long as wide; tempora longer than the eyes, arcuate; base slightly sinuate; vertex punctate at the side, foveæ small, mutually a litttle more distant than either from the eye, the arcuate groove deeper and wider in front; supra-antennal tubercles large, angulate, and behind each is a small puncture. *Antennæ* one-third longer than the head, the ninth and tenth joints transverse, twice as wide as long, the last joint wider than the tenth, as wide as long. *Prothorax* slightly narrower than the head, widest near and before the middle, very slightly sinuate anteriorly near the neck, posteriorly less convergent, minutely slightly sinuate behind the middle, thence straight; neck one-half, the base two-thirds of the pronotal width; disk impunctate, convex, with an elongate puncture before the middle, and a slightly impressed sulcus one-fifth from the base, connecting the three small deep foveæ. *Elytra*, across the shoulders, somewhat wider than the pronotum, sides slightly arcuate, nearly parallel, disk a little longer than wide, slightly

depressed; sutural lines arcuate, discal lines two-fifths as long as the suture. *Abdomen* not longer than the elytra, two dorsal segments with approximate, divergent carinæ. The ♂ characters are as follows: a deep transverse impression of the penultimate segment, the third and fourth, sinuate behind.

Habitat. Maryland, Virginia.

E. DIFFICILIS, *Lec.* Red, feebly and sparsely punctulate, pubescence fine, short, and dense. Length 1.2 mm. Plate XI., Fig. 109.

Head large, as long as wide, eyes small, prominent, tempora much longer than the eyes, convergent; base sinuate, with a median impression; vertex impunctate, highly polished, occipital foveæ small, pubescent, situated near and behind the middle, slightly more distant from one another than from the eyes, circumambient sulcus narrow, the parabolic very wide and deep behind the frontal ridge; supra-antennal tubercles very large, angulated externally. *Antennæ* one-third longer than the head, slender, club large, ninth joint not longer than the eighth, twice as wide as long; tenth one-half longer and wider than the ninth; the last joint very slightly wider than the tenth, nearly globular, annulate and acuminate at the tip. *Prothorax* narrower than the head, slightly wider than long, widest in the anterior third, sides, behind the point of the greatest width, convergent and broadly sinuate; base three-fourths as wide as the pronotum, and one-half wider than the neck; disk convex, with a deep, elongated, median puncture in the middle; one-fourth from the base is a narrow, feebly impressed, transverse sulcus, connecting a large, deep, median impression with the circular, pubescent, lateral foveæ near and behind the middle. *Elytra*, across the prominent shoulders, slightly wider than the prothorax and as wide as the head, sides parallel, arcuate; disk longer than wide, about as long as half of the head and the prothorax together, rather flat, sutural lines close, the lateral ones short, broadly impressed. *Abdomen* not narrower than the elytra, the first two segments

conspicuously carinate; space between the carinæ at the base pubescent, margin flat.

Habitat. Eastern States.

E. CONGENER, *Casey*. Form slender, head large, wider than long, prothorax as wide as the head, rather longer than wide, humeral width as great as that of the head, elytra slightly longer than wide; color brown, legs paler, pubescence short, coarse, dense, conspicuous. Length 1.5 mm.

Head slightly punctulate, eyes large, prominent, tempora very convergent, longer than the eye, base sinuate, impressed in the middle; more than one-third from the base are two minute, pubescent foveæ, mutually not more distant than either from the eye; the connecting sulcus is extended on to the tempora, the enclosed space narrow, convex, impunctate; frontal tubercles large, angulate, frontal ridge depressed in the middle. *Antennæ* one-half longer than the head, third to eighth joints moniliform; eighth smallest; ninth twice as wide; tenth longer and wider, two-thirds wider than the ninth; the last is as long as wide, slightly wider than the tenth, acuminate and annulate at the apex. *Prothorax* as wide as the head, widest before the middle, nearly as wide as long, feebly arcuate at the sides anteriorly, posteriorly convergent, nearly straight, feebly undulate; neck half as wide as the disk; disk minutely and sparsely punctulate, convex, with a small elongated puncture before the middle; one-fourth from the base a narrow, arcuate sulcus connects the deep, triangular, median impression with the deep, round, pubescent, lateral foveæ. *Elytra*, across the high shoulders, as wide as the the head; sides arcuate; disk slightly longer than wide, convex, impunctate, sutural lines parallel, lateral ones broadly impressed, abbreviated before the anterior third. *Abdomen* with the sides divergent posteriorly, first three dorsals equal, the two basal ones with approximate divergent carinæ. Legs slender. ♂, third segment minutely produced behind in the middle, fourth with a small tubercle in the center.

Habitat. Virginia.

E. LINEARIS, *Lec.* Form more parallel, pubescence coarse, color uniformly brown; surface punctulate. Length 1.3 to 1.6 mm. Plate XI., Fig. 107.

Head trapezoidal, wider than long, eyes large, tempora slightly arcuate, convergent, base sinuate, with a median impression, frontal margin straight; supra-antennal tubercles strong, angularly rounded, occipital foveæ far apart, in line with the posterior limits of the eyes; sulcus parallel to the sides, where it is deepest, wider toward the frontal margin; from this point it presents a surface slanting upwards to the triangularly elevated vertex. *Antennæ* nearly as long as the head and prothorax together, first joint rather robust; second much smaller, third to eighth equal, transversely globular; ninth twice as wide as long; eleventh as wide as the tenth, and one-half longer than wide, annulate near the acute tip. *Prothorax* slightly wider than the head, widest before the middle, sides slightly sinuate anteriorly, very convergent, the middle evenly arcuate, behind nearly straight; neck not half as wide as the middle, base two-thirds of the total width, disk broadly convex, median sulcus fusiform, widest and deepest near the center, connected with the transverse doubly-arcuate sulcus; the lateral foveæ are large and deep. *Elytra* rather flat inside of a triangle limited by the base and two lines drawn from the shoulders to the posterior end of the suture, the remaining triangles being more convex and declivous; across the shoulders they are as wide as the prothorax, and near the tip are one-fifth wider; sides divergent, nearly straight behind; discal lines abbreviated before the middle, sutural lines deep, interval very slightly dilated behind the middle, the three basal foveæ rather deep. *Abdomen* broadly margined, sides of the first three segments parallel; carinæ of the first and second segments short, including one-fifth of the total width. The under surface of the head and abdomen more strongly punctured. ♂, last ventral lozenge-shaped, punctate, carinate in the middle.

Habitat. East of the Mississippi river.

E. CONFLUENS, *Lec.* Form slender, depressed, sides of the elytra and abdomen parallel; surface punctulate. Length 1.2 to 1.5 mm. Plate XI., Figs. 110 and 112.

♂ *Head* broader than long, trapeziform, one-fourth shorter from the frontal margin to the base than the width across the very prominent tempora; base sinuate and shortly carinate in the middle, tempora acutely rounded; eyes not prominent, sides, from the tempora to supra-antennal tubercles, nearly straight, slightly sinuate; frontal margin straight, slightly produced in the middle, as wide as the head is long; disk very coarsely punctured, flat, the inter-ocular foveæ very small, mutually as distant as either from the eye; the grooves are parallel, broadly arcuate in the transverse frontal portion, included space smooth or less deeply punctured, mandibles prominent. *Antennæ* one-third longer than the head, third to eighth joints transversely moniliform; ninth and tenth gradually wider; eleventh ovate, truncate at the base, where it is slightly wider than the tenth and four times wider than the funicle, the length and width about equal. *Prothorax* narrower than the head, widest before the middle, as wide as long, sides rounded in the middle, straight and convergent toward the neck and base, slightly sinuate opposite the lateral foveæ; base broadly arcuate; disk punctate with a deep oblong fovea before the middle, running out into a shallow, longitudinal sulcus, reaching into the triangular median fovea one-fourth from the base; lateral foveæ large, deep, very faintly connected with the median ones. *Elytra* densely pubescent, faintly punctulate, as long as wide, sides nearly parallel; disk flat, sutural lines nearly straight, parallel, base trifoveate, discal lines deep near the base, not reaching the middle; shoulders prominent. *Abdomen* longer than the elytra, the first and second dorsals carinate. The sexual differences are conspicuous, the head of the ♂ being shorter, the mandibles strong, prominent, the antennæ more slender, and the abdomen shorter; the third ventral segment is bisinuate in the middle behind, the fourth depressed at the middle of the base and covered by tufts of hair; the fifth has

two short transverse folds on each side of the middle; the last is lozenge-shaped, punctured, carinate longitudinally.

Habitat. Atlantic slope from North to South.

E. PERTENUIS, *Casey*. ♀ very slender, linear, pubescence fine and dense; surface nearly opaque. Length 1 mm.

Head nearly as long as wide, very large; eyes large, nearly invisible from above, tempora arcuate, longer than the eye; base sinuate, vertex nearly flat, distinctly punctate; in a line through the center are two minute, pubescent foveæ, mutually equally as distant as either from the eye; connecting sulcus deep, convergent, angulated and transverse behind the straight frontal margin; frontal ridge sharp. *Antennæ* very short, third to tenth joints transverse, ninth and tenth wider; tenth three times as wide as long; eleventh wider, as long as wide, acuminate. Labrum bilobed. *Palpi* with the second joint clavate, the third small, transverse, fourth conical, twice as long as wide. *Prothorax* narrower than the head, longer than wide, widest before the middle, feebly sinuate at the sides anteriorly, nearly straight posteriorly; neck one-half the pronotal width and four-fifths that of the base; disk convex, with an oblong puncture before the middle and cruciform impression near the base, the lateral branches not reaching the small foveæ. *Elytra*, across the shoulders, not wider than the head, sides nearly parallel; disk one-fourth longer than wide, the discal lines very short, shoulders prominent. *Abdomen* with the third segment slightly wider than the elytra, the first two carinate. Legs long.

Habitat. Virginia. Unknown to us.

E. CALIFORNICUS, *Casey*. Form slender, depressed; pubescence fine, short, dense; body brown, polished. Length 1.3 mm.

Head wider than long, tempora rounded, convergent, not prominent; base sinuate; vertex depressed; in a line with the middle of the eyes are two small, nude, foveæ, mutually as distant as either from the eye, and connected by a feeble

arcuate groove; frontal margin nearly straight, the lateral tubercle small, prominent; surface rather rough, punctured. *Antennæ* three-fourths the length of the head and prothorax together, the last three joints gradually wider, the last oval, as long as the three preceding together. *Prothorax* punctate, slightly shorter and narrower than the head, wider than long, widest before the middle, sides convergent, nearly straight towards the base, which is two-thirds as wide as the disk; neck very slightly narrower, disk with a slightly elongate fovea near the center; one-fourth the length from the base is a deep, transverse, impression; lateral foveæ deep, rounded, not connected with the median impression. *Elytra*, across the shoulders, slightly wider than the prothorax, sides nearly parallel, very feebly arcuate, disk as long as wide; sutural lines deep, arcuate, discal lines fine, slightly arcuate, half the length of the elytra; base trifoveate, punctate. *Abdomen* narrower and longer than the elytra, sides parallel, punctate; the base of the first two segments is impressed in the middle and bears obsolete carinæ. Legs short, tarsi short and thick.

Habitat. California. (Lake Tahoe).

E. LONGISSIMUS, *Brend.* Pale testaceous, polished, impunctate, sparsely pubescent, very elongate-linear. Length 1.6 mm. Plate XI., Fig. 114. Plate XII., Fig. 115.

Head, including the eyes, as long as wide, tempora slightly convergent, straight from the rounded posterior angles to the eyes; frontal tubercle prominent, rounded, the angular frontal margin crenate and elevated between the tubercles; occipital foveæ large, sulcus straight to the arcuate frontal portion and fairly wide; enclosed surface convex, occiput emarginate and impressed in the middle; eyes small, not prominent. *Antennæ* one-half longer than the head, first and second joints cylindrical, longer than wide, as wide as the ninth; third to eighth very small, sub-globular; ninth not longer, tenth twice as wide and long as the ninth, the last wider than the tenth and one-fourth longer than wide, obliquely annulate near the subacute tip. Palpi, last joint as large as the second antennal

joint, more convex inside. *Prothorax* as wide and long as the width of the head, widest across the anterior third where it is strongly arcuate; anteriorly the sides are strongly convergent, slightly sinuate; posteriorly convergent, sinuate near the lateral foveæ, thence rounded toward the base, which is three-fourths as wide as the disk and one-half wider than the neck; disk convex with an oval fovea behind the apical third, and a doubly arcuate, not very deep sulcus one-fourth from the base, which is deeper or foveate at the angulated middle and ends in two large lateral foveæ. *Elytra*, across the very high shoulders, as broad as the prothorax, near the tip one-fourth wider, the width here equalling the length of the suture; sides very slightly arcuate, nearly parallel; base sinuate; tip straight; sutural lines slightly impressed, basal punctures three, the outer one resembling a short impression. *Abdomen* longer than, and as wide as the elytra, the two basal segments carinate, border broad, parallel. Legs, (♂) tibiæ and tarsi dilated, short; fourth ventral impressed at the base, fifth transversely impressed in the middle, last lozenge-shaped, carinate.

Habitat. South Carolina, Georgia.

EUTYPHLUS, *Lec.*

(*Nicotheus* Casey.)

Body elongate, linear, resembling *Euplectus*. The head with large antennal foveæ before and above the eyes; prothorax rectangular at the sides of the base; prosternum carinate; abdomen with the fourth dorsal segment not, or very slightly longer than the third. ♀ with rudimentary eyes.

E. TIBIALIS, *Casey*. Form robust, slightly depressed, pubescence short, brown conspicuous. Length (♂) 1.2 mm. (♀) 1.4 mm. Plate XII., Fig. 119, ♀; Fig. 120, ♂.

♂ *Head* as long as wide, eyes moderately prominent, small, coarsely facetted, tempora convergent, feebly arcuate, exca-

vated above and below the eye, sides of the vertex straight, convergent to the frontal margin; supra-antennal tubercles strong, angulate; frontal margin convex in the middle and declivous at the tip; in a line with the anterior limits of the eyes are two pubescent foveæ, mutually two-thirds more distant than either from the eye, connected by a parabolic sulcus; the included space impunctate; labrum truncate anteriorly. *Antennæ* not as long as the head and prothorax together, first and second joints stout, ovate, nearly equal; third to seventh small, gradually transverse; eighth to tenth gradually increasing in width, nearly equal in length; eleventh sub-globular, annulated near the acute tip. Last joint of the maxillary palpus thick, one-sided, acute at the tip. *Prothorax* widest across the anterior third where the width equals that of the head, as wide as long, evenly arcuate at the sides; posteriorly the sides are nearly straight, forming a slightly obtuse angle with the base; disk polished, impunctate, convex, with an abbreviated, linear sulcus just before the middle and a transverse, slightly angulated groove one-fourth from the base, connecting the pubescent lateral foveæ; the space behind the transverse sulcus is rough, with a median carina. *Elytra*, across the prominent shoulders, as wide as the prothorax, sides divergent, moderately arcuate, disk feebly convex, indefinitely punctulate, wider than long, and one-fourth longer than the pronotum; base bifoveate, the sutural lines parallel, the discal impression conspicuous, more than one-third as long as the suture. *Abdomen* short, broad, border retuse, segments sub-equal, the first and second with two short, divergent carinæ at the base. Legs long, thighs clavate, tibiæ dilated toward the tip. ♀, form more slender, longer than the male, eyes rudimentary, consisting of three or in some cases two ocelli; the elytra are comparatively longer, the sides more arcuate, the abdomen longer, and the tibiæ not dilated.

Habitat. Virginia.

BIBLOPORUS, *Thomson.*

(*Faliscus*, Casey.)

Body slender; antennal club three-jointed; prosternum carinate; fourth dorsal not prolonged.

B. BICANALIS, *Casey.* Dark brown, pubescence short and fine; antennæ and legs paler. Length 1.1 mm.

Head small, wider than long, eyes large, coarsely facetted, prominent, very near the base, tempora short, nearly transverse; vertex flat, polished, impunctate, with two small, deep, naked foveæ, mutually twice as distant as either from the eye; on each side of the vertex is a very shallow sulcus running from the occipital foveæ forward, near the frontal margin turning inwards without meeting the opposite sulcus, where it is much more deeply impressed; supra-antennal tubercles flat, crossed by a fine impressed line; frontal margin convex. *Antennæ* not as long as the head and prothorax together, slender; first joint larger, second oblong, conical; third longer than wide, fourth to sixth globular; seventh thicker, globular, eighth as thick as the seventh and slightly transverse; ninth larger, of the same form; tenth nearly as long as the ninth, transverse, one-half wider than long; eleventh wider than the tenth, little longer than wide, acuminate. Maxillary palpus with the last joint fusiform; under surface of the head with capitate hairs. *Prothorax* widest before the middle, sides evenly arcuate, straight toward the neck and the basal angles; the neck is two-thirds as wide as the base; disk polished, indistinctly punctulate, with a nude, oblong puncture near the base, continued forward as a fine shallow impression, not reaching the middle of the disk; on each side is a shallow, longitudinal, impression, reaching the basal angle; lateral foveæ and transverse basal sulcus wanting. *Elytra*, across the shoulders, slightly wider than the prothorax, sides arcuate, sutural lines close together, feebly arcuate. Discal lines deep, one-third as long as the suture; disk indefinitely and closely punctulate. *Abdomen* shorter and narrower than the elytra,

margin narrow, the segments sub-equal, the first two with short carinæ at the base. Legs long, thighs robust, tibiæ slender; male intermediate thighs lunate, the intermediate tibiæ with an internal tooth.

Habitat. New York.

FARONUS, *Aubé.*

Antennæ inserted beneath the moderately distant frontal tubercles, joints moniliform, gradually slightly larger; palpi short, the last joint oval or elongate oval; vertex trifoveate; eyes moderately prominent, the facets not very large. Prothorax commonly wider than long, with two small foveæ near the center and a transverse excavation limited laterally by a carina which separates it from the lateral fovea, posteriorly by a roof-shaped transverse carina which divides it from the basal line. Elytra usually with nearly straight divergent sides, the line of the sides if prolonged touching the sides of the prothorax and the eyes anteriorly, and the first three segments posteriorly; the disk is depressed, with deeply interrupted or strongly foveate lines. Abdomen, basal segment shorter than the two succeeding ones, broadly margined, the segments quite flexible and somewhat retractile; segments six in number. Pubescence usually very coarse and long. Legs slender, short, tarsi short, the first two joints very short, the last with two equal claws. Posterior coxæ approximate, slightly transverse. Antennæ with the third joint smallest. The following table will enable the student to identify his specimens.

TABLE OF THE SPECIES OF FARONUS.

1^2 Prothorax with two foveæ on the disk before the middle.

2^2 Prothorax nearly as wide as long, sides evenly arcuate, discal foveæ faint, not connected with the basal transverse impression by a longitudinal one. - - - - - - - - - - - *tolulæ.*

2^1 Prothorax wider than long, foveæ connected with the transverse basal impression by a longitudinal one.

Sides of body nearly parallel: head very transverse, tempora rectangular with the base. - - - - *corticinus.*

Sides of the body divergent; head not much wider than long, tempora convergent towards the base, slightly arcuate. *cavicollis.*

Sides of body divergent; head very small, not much wider than long, sculpture of vertex less deep; tempora arcuate, but not angular to the base. - - - - - - *parviceps.*

1[1] Prothorax without discal foveæ, the basal transverse impression with three deeper punctures. - - - - - - - *isabellæ.*

F. TOLULÆ, *Lec.* Dark brown, polished, pubescence coarse, long, abundant on every part of the body; antennæ and legs yellowish. Length 2.1 mm. Plate XII., Fig. 125.

Head without the eyes, as long as wide, eyes large, prominent, tempora very convergent, nearly transverse, as long as the eye, with the posterior part of the eyes and the base forming a regular arch; sides near the eyes sinuate, frontal margin sinuate, supra-antennal tubercles strong; in a line with the middle of the eyes are two small, circular foveæ, mutually three times more distant than either from the eye, frontal fovea oblong, large and deep; space separating the three foveæ slightly elevated. *Antennæ* half as long as the entire body, first joint cylindrical, strong, twice as long as wide, flattened above; second shorter, oval, one-half longer than wide; third to tenth gradually increasing in width, third smallest, longer than wide, eighth slightly transverse, ninth as thick as the first; tenth a little larger transversely oval, one-fourth wider than long, eleventh ovate-acuminate, one-half longer than wide. Last palpal joint twice as wide as long, oval, somewhat more arcuate inside, the second joint larger than the third; on the under side of the head, behind and below the eyes each side, is a small acute tubercle. *Prothorax* sub-globose, widest in the middle, nearly as long as wide, the base twice the width of the neck; the discal punctures are hardly visible, the basal transverse excavation and lateral foveæ deep. *Elytra* much depressed, the base, sides, and posterior limit nearly straight; sides and tip declivous, discal and sutural lines with deep foveolæ before the middle, only one intermediate puncture near the base; the disk, across the shoulders, is

as wide as the prothorax, across the tip one-half wider, and equal to the length of the suture. *Abdomen*, across the second segment, wider than the elytra. Legs rather long and stout, the third tarsal joint three times longer than the second.

Habitat. Virginia.

F. CAVIFRONS, *Casey*. Brown, impunctate, polished; pubescence long, coarse, and recumbent, especially long on the tempora and abdomen. Length 1.9 mm. Plate XII., Fig. 126.

Head, behind the large prominent eyes, nearly as wide as the distance from the frontal margin to the base, which is continuously arcuate with the tempora; sides, for a short distance before the eyes, convergent, thence forming an obtuse angle with the parallel antennal tuberculations; disk moderately convex, deeply excavated between the antennal tubercles, leaving the frontal margin very sharp in the middle; in the eye line are two small, faintly impressed foveæ, not quite twice as distant from one another as from the eye. *Antennæ* very pubescent, longer than the head and prothorax together; first joint oblong-oval, as wide as the ninth joint, nearly twice as long as wide, second oval, shorter, equal in thickness to the first; third smallest, globular, fourth to tenth sub-equal, moniliform, slightly and gradually increasing in size; the tenth is rather wider than long, eleventh ovate, little wider than the tenth, and one-half longer than wide. Last joint of the maxillary palpi nearly fusiform, twice as long as wide. *Prothorax* wider than the head, one-fifth wider than long just before the middle, where the sides are evenly rounded; thence nearly straight to the neck, and slightly sinuate toward the base; neck half as wide as the base, which is about three-fourths of the greatest width; disk with two small, slightly impressed foveæ before the middle, and the basal structure given in the generic description, modified by the lateral carinæ including little more excavated space than one-half of the basal width. *Elytra* longer than wide, slightly divergent at the sides, width

of the shoulders but little greater than that of the thorax, three-fourths as wide as across the tip, discal lines quadrifoveate; intermediate foveæ two, lateral declivity slightly concave. *Abdomen* with a pubescent transverse line on the basal segment. Legs short and slender.

Habitat. Middle Calfornia.

F. CORTICINUS, *Casey*. More elongate than the preceding, pale brown, pubescence shorter, finer, surface impunctate. Length 1.5 mm. Plate XII., Fig. 127.

Head wider than long, four-fifths as wide as the prothorax, trapeziform, eyes small, situated in the middle of the straight, anteriorly convergent, sides; tempora rather prominent, rounded, frontal margin slightly convex, less than two-thirds the distance across the tempora, front deeply excavated; vertex with two small punctiform foveæ, mutually less distant than either from the eye. *Antennæ* one-third longer than the head and prothorax together, first joint longer and little thicker than the second; the second is nearly one-half longer than wide, oval; third to ninth smaller, moniliform, gradually shorter, and wider than long; tenth and eleventh slightly larger, the former transverse, the latter wider, and a little longer than wide, as long as the two preceding together. The fourth joint of the maxillary palpi is longer than wide, compressed oval, with a terminal pencil of hair. *Prothorax* widest in the middle, evenly rounded, very slightly sinuate toward the base; discal foveæ just before the middle, mutually distant one-fifth of the pronotal width; basal excavation foveate in the middle, and limited on the angle by the lateral carinæ; lateral foveæ large, extending to the lateral basal angle. *Elytra* a little wider across the shoulders than the prothorax, across the tip less than one-fourth wider, the width here being equal to the sutural length; disk depressed, the sutural lines punctate at the base, the discal lines with two large punctures near the base, intermediate punctures three in the longitudinal row. *Abdomen* slightly longer and wider than the elytra, marginal border one-seventh of the segmental width; the basal

segment is shorter than any one of the succeeding segments, and bears on each side of the middle a transverse pubescent line. Legs short, stronger than those of the preceding species.

Habitat. Middle California.

F. PARVICEPS, *Mæklin*. Dark brown. Length 2 mm.

Head wider than long, much smaller than in any of the preceding species; the frontal impression is more transverse, the foveæ not so well impressed and situated in a line with the anterior limits of the eyes, tempora arcuate. *Antennæ* longer than the head and prothorax, the basal joint longer than in the preceding species, the ninth and tenth joints transverse. *Prothorax* widest behind the middle; the foveæ before the middle are near together, not connected with the transverse basal impression. *Elytra* with the sides straight, divergent, half as long again as the prothorax, shoulders not prominent. *Abdomen* with the sides divergent, the first segment apparently half as long as the second. In the living specimen this proportion may possibly be different.

Habitat. British Columbia.

This description is taken from a drawing made thirty years ago from a specimen in Dr. Leconte's cabinet. We do not recollect whether or not it has the transverse pubescent line on the first abdominal segment.

F. ISABELLÆ, *Lec.* Black, elytra, legs, and antennæ red. Length 2 mm.

Head large, as wide as long, the frontal foveæ large and deep. *Antennæ* as long as the head and prothorax together, first joint oblong oval; second of the same form, as long as the width of the first; third smallest, as long as wide; fourth to sixth little longer than wide, one-half wider than the third; seventh to tenth gradually wider, not longer, the tenth being twice as wide as the eighth; the last joint is wider than the tenth, and one-half longer than wide, oval. *Prothorax* of the same form as in *F. cavifrons*, without discal foveolæ, the basal

impression less deep. *Elytra* red, of the same form as in *F. cavifrons*. *Abdomen* with the first segment very short, and narrower than the elytra; the second is twice as long as the first and equal to the third or fourth segment, gradually increasing in width from base to apex, the rest of the segments rapidly decreasing in width and seemingly so in length, as they are retracted in dead specimens.

Habitat. San Francisco, Cal.

APPENDIX.

ANOPS, *n. g.* (from *a*, *wanting*, and ὤψ, *eye*.)

ANOPS AMPLYOPONICA, *n. sp.* Uniform umber brown, alutaceous, finely pubescent, of the general form and character of *Batrisus;* eyes wanting, sides of the head with a prominent spine; fourth dorsal segment as long as the others taken together, not margined; posterior coxæ approximate. Length 3.4 mm.

Head as wide as long, vertex quadrate, carinate at the sides, the carinæ nearly obsolete posteriorly, with two shallow foveæ less than one-fourth from the base, and mutually three times farther distant than either from the basal carinæ; circumambient sulcus shallow near the foveæ, deeper and wider near the frontal margin. Supra-antennal tubercles retusely angulate outside and separated by a notch from the arcuate frontal margin; clypeus evenly rounded, punctured; sides of the head continuously convex with the posterior part of the vertex and the gular region, and with a strong, pointed, conical spine (perhaps bearing an ocellus) in the position usually occupied by the eyes; occiput carinate in the middle; gula unicarinate; neck faintly carinate; mentum and labrum very short, emarginate; antennal cavities shallow. *Palpi* with the second joint very slightly sigmoid, third quadrate, fourth not thicker than

the third, fusiform, five times longer than wide, acuminate. *Antennæ*, excluding the last joint, as long as the head and prothorax, first to eighth joints obconical, regularly decreasing in size; ninth and tenth respectively as wide as the second and first, sub-globose, nearly transverse; eleventh one-half thicker than the tenth, more convex outside, as long as the three preceding. *Prothorax* widest across the anterior fourth, anterior circumference semi-circular, sides straight from the anterior third to the basal angle, rounded, not margined; disk evenly vaulted, with a large, deep, median fovea, lateral foveæ small and shallow; on each side of the large fovea is an inconspicuous tubercle, and there are two shallow impressions on each side near the base; median basal carina present, median, transverse, and lateral sulci wanting. *Elytra* rather convex, with obsolete shoulders, as in some Californian *Batrisi*, the sutural lines close together, discal lines wanting; there are two shallow impressions near the base. *Abdomen* wider than the elytra, nearly as long as the prothorax and elytra, without a visible line of junction between the dorsals and ventrals above, not margined; basal dorsal segment three times wider than long, basal foveæ deep, the median twice as wide as the lateral ones; second and third segments sub-equal, together as long as the first; fourth half as long as the abdomen; fifth very short, emarginate at the tip. Prosternum short, the coxal cavities continuous, coxæ large, conical; mesosternum carinate, narrow anteriorly, bilobed, the posterior coxæ separated by a distance equal to the length of the last palpal joint. Legs, coxæ, and trochanters simple, not spinous, femora strongly clavate, tibiæ moderately arcuate, the posterior ones with a very small terminal spinule inside; tarsi half as long as the tibiæ, first joint short, second longest, more than half the length of the tarsus, thicker at the distal end, third cylindrical, thin, with but one perceptible claw. To all appearance the unique specimen described is a male; the ventral segments correspond to the dorsals in length, the fourth segment bears a large, deep, transverse fovea, and the fifth is semi-circular.

Habitat, Westmoreland County, Pennsylvania, with *Amplyopone pallipes.*

This insect represents the genus *Amaurops* of Europe, differing in the absence of the abdominal margin, and is related to some of the Japanese *Batrisi* (*longicornis*, Sharp, and *solitarius*, Sharp) from which it differs in the absence of eyes and the extreme length of the fourth dorsal segment. For the loan of this interesting species we are indebted to Mr. P. Jerome Schmitt, of St. Vincent College, Pennsylvania, to whom is also due the honor of its discovery. The specimen was received after the rest of the monograph was in press, so we were unable to insert this description in its proper place.

BATRISUS, *Aubé.*

B. FURCATUS, *n. sp.* Saturated red-brown, faintly punctulate; elytra brighter; pubescence sparse. Length 1.8 mm.

♂ *Head*, including the prominent eyes, as long and wide as the prothorax; lateral carinæ of the vertex nearly parallel, circumambient sulcus parabolic; the perforate nude foveæ are inside the sulcus; middle portion convex, carinate from the middle to the base; frontal margin sparsely punctate, not depressed in the middle, anterior margin trisinuate, the median sulcus not so deep as the lateral ones; the black, pointed spinulæ end in long yellow claws, the lateral lobes only pendant at the tips; clypeus porrected somewhat in the form of an equilateral triangle, pointed in front, edges black, sides punctate, upper edge, limiting the sub-frontal excavation, arcuate; the culmen bears a short black carina with two tufts of hair, and on each side is a small emargination corresponding to the outer sinuses of the frontal margin. *Antennæ* with the second, third, fifth and seventh joints equal, obconical, fourth and sixth equal, smaller, the eighth half as long as the seventh, transverse, rounded; ninth as long as the eighth and twice as wide; tenth three times as wide as the eighth and nearly as long as wide, the fovea large; eleventh not wider

than the tenth, ovate-acuminate, truncate at the base. *Prothorax* with a very fine, nearly entire median sulcus, and small, acute, basal spines. *Elytra* narrow-shouldered, the humeri not prominent, space between the sutural lines punctulate. *Abdomen* narrower at the base than the elytra, the foveæ nearly equal in width, ventral foveæ large, square; anterior tarsi with the larger claw cleft; ♀ unknown. This species ranks next to *B. virginiæ*.

Habitat. Southern Pennsylvania. (H. Ulke.)

Since the descriptions of *Batrisi* were in press we have received specimens of *B. foveicornis* Cas., and *B. punctifrons*, Cas., and both species seem entitled to specific distinction. The student is therefore requested to insert in the synopsis after *B. globosus* the following:

Clypeus conical, not reflexed laterally; pronotum feebly sulcate.
Tenth antennal joint larger in the ♂ than in the ♀ - *foveicornis*.
Tenth antennal joint of ♂ not larger than in the ♀ - *punctifrons*.

B. FOVEICORNIS, *Casey*. Red, impunctate; pubescence long, sparse. Length 1.9 to 2.0 mm.

Head as wide as long, face nearly perpendicular to the vertex, which latter is wider than long, not very convex, carinate in the middle of the occiput and at the sides, fovea nude, lateral grooves arcuate, dividing the thinly punctured margin in the middle; clypeus large, conical, not reflexed at the sides, sub-frontal groove remarkably inconspicuous. *Antennæ* with the first joint sub-cylindrical, as wide as the ninth, and twice as long as wide; second, one-third shorter and narrower, third to seventh longer than wide, gradually shorter, eighth as long as wide, ninth as long as the eighth, transverse; tenth much wider, globose when viewed from above, flattened below, with a perforate fovea, which in some specimens is very large. Eleventh wider than the tenth and as long as the three preceding together. *Prothorax* with the foveæ and sulci deep, the median sulcus short, disappearing behind the middle, or very much shorter; basal spines small, discal carinæ rather

indistinct or sometimes absent. *Elytra* with humeral ridges not spinous. *Abdomen* with the basal median fovea not half as wide as the lateral. The ♀ has the clypeus remarkably flat, strongly punctured laterally, less so in the middle, not separated from the frontal margin. Median basal abdominal fovea wider; tenth antennal joint not modified.

Habitat. Cincinnati, Ohio.

B. PUNCTIFRONS, *Casey*. Red-brown to black, impunctate, pubescent, antennæ, legs, and palpi dull-red. Length 1.8 to 1.9 mm.

Head carinate at the sides of the vertex, foveæ nude, circumambient sulcus interrupted in front, where the frontal elevation is connected with the rather flattened median arch; between the occipital foveæ is a transverse impression; the frontal margin is densely punctured, anteriorly declivous to the interantennal line, the declivous portion triangular, slightly truncate in front; sub-frontal groove very narrow, sharply cut; clypeus conical, edges not reflexed, densely punctured. *Antennæ* with the first joint as wide as the tenth, one-half longer than wide, the joints gradually decreasing in size to the eighth; eighth transversely oval, ninth and tenth not longer than the eighth, gradually wider, shorter inside, with the usual perforate fovea on the tenth; eleventh more than twice as wide as the tenth, and larger than the three preceding joints together, ovate-acuminate. *Prothorax* with the median sulcus fine, perceptible only in a favorable light, stronger near the fovea, spines very small and fine. *Abdominal* basal foveæ nearly equal. The ♀ differs in the vertex being uniformly convex and scabrous; the antennæ are of the same form as in the ♂.

Habitat. Southern Pennsylvania.

ERRATA.

Some typographical and clerical errors having crept into the first part of this Monograph the student is requested to make the following changes:

Page 224, b', for cylindrical read elliptical.
Page 225, line 7, for absolutely read obsoletely.
Page 237, after description of *Ct. zimmermanni*, add, Habitat. Southern States.
Page 239, lines 14 and 15 should read, Habitat. Western slope of the Sierra Nevada. Montana. (Wickham).
Page 242, line 6, after Habitat., add, Mississippi Valley, south of 36°.
Page 266, last line, for Sauley read Saulcy.
Page 268, II, for wide read nude.
Page 271, line 2, for front read fourth.
Page 271, line 12, for *albinica* read *albionica*.
Page 294, line 6, for impunctuate read impunctate.
Page 294, line 17, for TRIGMA read TRIGONA.

In the explanation of Plate VI., Figs. 13 and 15 are transposed; read therefore:

Fig. 13, *Chennium* (*Atinus*) *monilicorne*.
Fig. 15, *Tmesiphorus costalis*.

PLATE X[1].

Fig. 78, *Batrisus ferox.*
Fig. 79. *B. ionæ.*
Fig. 80. *B. riparius.*
Fig. 81. *B. schaumii.*
Fig. 82. *B. zephyrinus.*
Fig. 83. *B. cicatricosus.*
Fig. 84. *B. albionicus.*
Fig. 85. *B. occiduus.*
Fig. 86. *B. scabriceps.*
Fig. 87. *B. lineaticollis.*
Fig. 88. *B. frontalis.*
Fig. 89. *B. globosus.*
Fig. 90. *B. cephalotes.*
Fig. 91. *B. trianguliter.*
Fig. 92. *B. spretus.*
Fig. 93, a. Antennæ of *B. denticornis.*
Fig. 93, b. Antennæ of *B. trianguliter.*
Fig. 93, c. Antennæ of *B. nigricans.*

1 Note. All the figures of Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.

PLATE X.

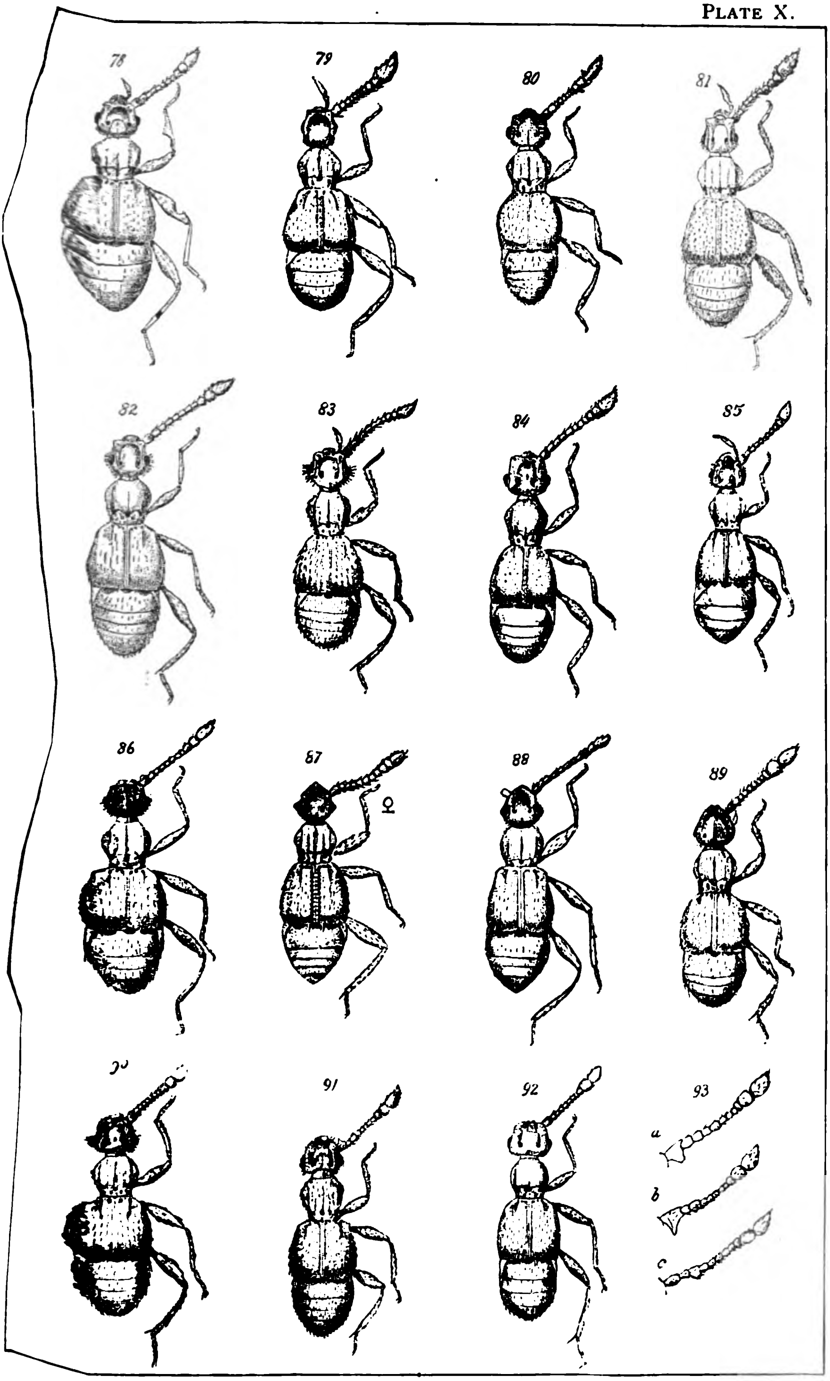

PLATE XI[1].

Fig. 94. *Trimium convexulum.*
Fig. 95. *T. dubium.*
Fig. 96. *T. thoracicum.*
Fig. 97. *T. parvulum.*
Fig. 98. *T. impunctatum*
Fig. 99. *Actium pallidum.*
Fig. 100. *Rhexidius granulosus.*
Fig. 101. *R. canaliculatus.*
Fig. 102. *Oropus striatus.*
Fig. 103. *Rhexius insculptus.*
Fig. 104. *Thesium cavifrons.*
Fig. 105. *Trimioplectus obsoletus.*
Fig. 106. *Euplectus crinitus.*
Fig. 107. *E. linearis.*
Fig. 108. *E. interruptus.*
Fig. 109. *E. difficilis.*
Fig. 110. *E. confluens.*
Fig. 111. ♂ sexual ventral marks of *E. spinifer.*
Fig. 112. ♂ sexual ventral marks of *E. confluens.*
Fig. 113. ♂ sexual ventral marks of *E. rotundicollis.*
Fig. 114. ♂ sexual ventral marks of *E. longissimus.*

1 Note. All the figures of the Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.

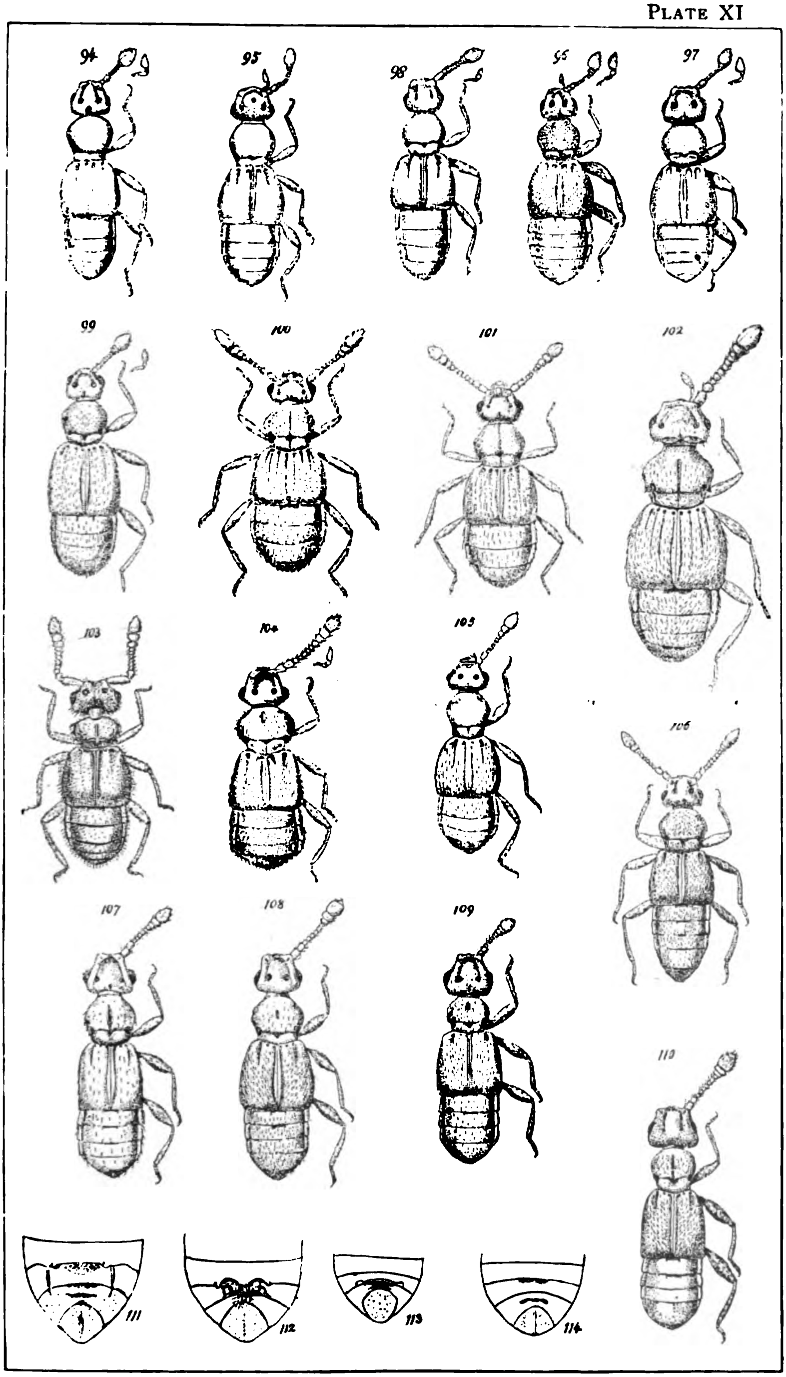
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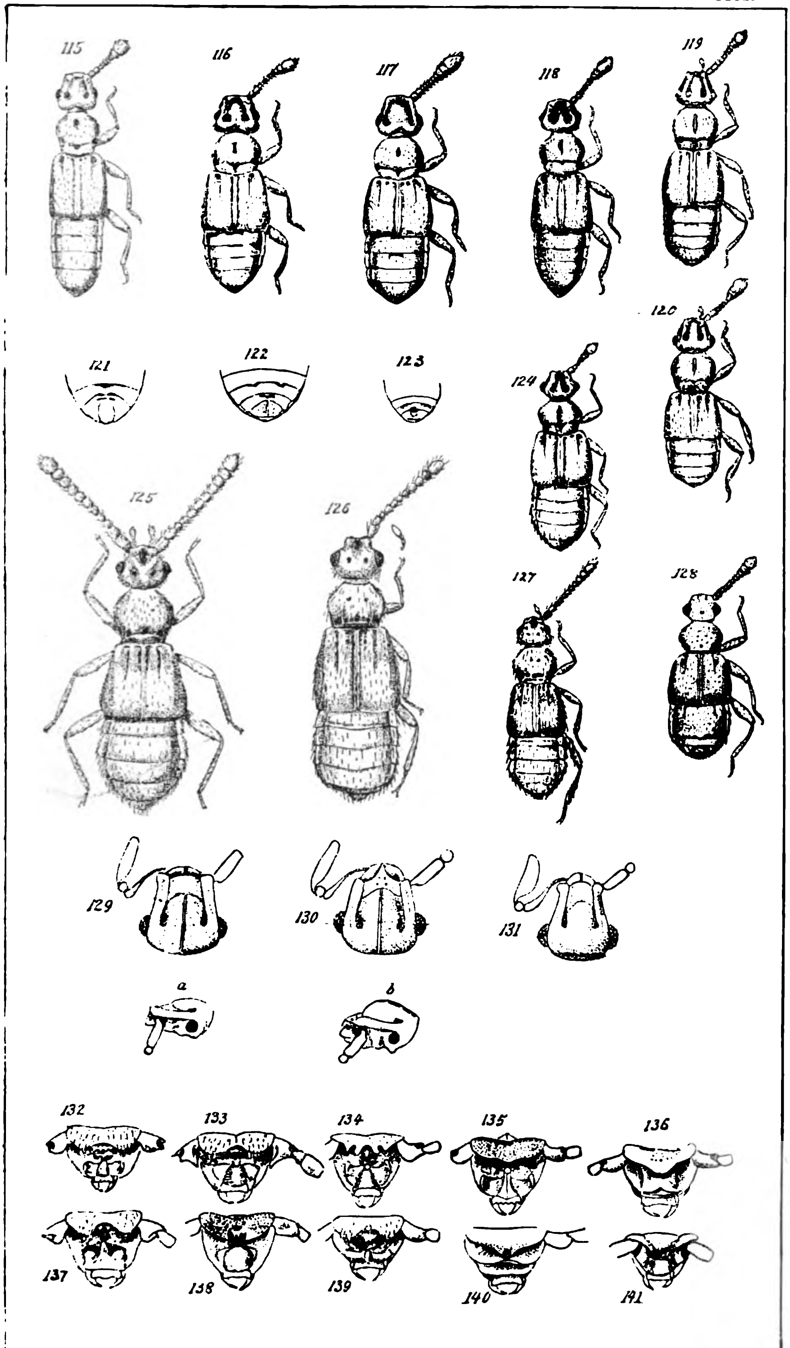
PLATE XII.

Fig. 115. *Euplectus longissimus.*
Fig. 116. *E. rotundicollis.*
Fig. 117. *E. spinifer.*
Fig. 118. *E. planipennis.*
Fig. 119. *Eutyphlus tibialis* ♀.
Fig. 120. *E. tibialis* ♂.
Male sexual ventral marks of:
Fig. 121. *Euplectus crinitus.*
Fig. 122. *E. interruptus.*
Fig. 123. *Trimioplectus obsoletus.*
Fig. 124. *Euplectus fossulatus.*
Fig. 125. *Faronus tolulæ.*
Fig. 126. *F. cavifrons.*
Fig. 127. *F. corticinus.*
Fig. 128. *Nisaxis tomentosa.*
Fig. 129. Head of ♀ *Machærodes carinatus;* a, profile.
Fig. 130. Head of ♂ *Machærodes carinatus;* b, profile.
Fig. 131. Head of *M. tychoides.*
Face (front, clypeus and labrum) of:
Fig. 132. *Batrisus cephalotes.*
Fig. 133. *B. trianguliter.*
Fig. 134. *B. frontalis.*
Fig. 135. *B. globosus.*
Fig. 136. *B. schaumii.*
Fig. 137. *B. denticornis.*
Fig. 138. *B. scabriceps.*
Fig. 139. *B. virginiæ.*
Fig. 140. *B. riparius.*
Fig. 141. *B. zephyrinus.*

1 Note. - All the figures of the Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.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NOTES ON TRICHINÆ.

S. CALVIN.

Some years ago a series of observations was conducted in the Biological Laboratory for the purpose of ascertaining facts concerning the prevalence of trichinæ among Iowa swine. The work in the laboratory was supplemented by observations made by students and others at a number of different localities throughout the state. Specimens of muscle taken from some hundreds of individuals were examined, but press of other duties interrupted the work before it was regarded as finished. Without entering into details the results as far as ascertained may be briefly stated as follows:—

I. Hogs kept for some time at our local slaughter yards and allowed to feed on offal show a high percentage of animals affected with trichinæ. Observations made in different parts of the state agreed closely and showed that among hogs so fed one in every ten or twelve contained these muscle parasites. Only a small proportion of those having the parasites, however, contained them in sufficient numbers to be dangerous to persons eating the uncooked flesh.

II. Hogs kept in towns by private families and fed in small close pens also show a high percentage of trichinous individuals.

III. Hogs coming from the farms, fed on corn and fattened in large numbers in open fields, are almost entirely free from trichinæ. These are the animals that supply the great packing houses, and the fact is that an examination of more than three hundred specimens from as many different individ-

uals, kindly furnished by two packing houses, showed not a a single case containing trichinæ.

An animal obtains trichinæ only by eating the flesh of some other individual animal already infested. If a single trichinous hog finds its way to our local slaughter yard, it will, when killed, transmit trichinæ to all other hogs that feed upon any of the muscular parts thrown out with the refuse; these will in turn transmit the parasites to their successors, and thus we may have from any given yard a continuous supply of infected animals. Rats, from their cannibal and omnivorous habits, are particularly subject to inoculation with trichinæ. Rats often fall victims to the omnivorous appetite of the hog, and it is quite certain that in many cases the rat is the direct cause of infection among swine. In the case of the private family hog that lives a solitary life in close quarters, rats are probably always the immediate source of the parasites, when parasites are present. Our farm-fed hogs, living on corn and not very closely confined, rarely have opportunity to indulge their liking for flesh, and as a rule they are wholly exempt from trichinæ. The flesh of such animals may be purchased and eaten with a sense of security from danger arising from muscle parasites, that is well nigh absolute.

Neglected cats, old individuals that have been compelled to shift for themselves in cities and villages, are almost always swarming with trichinæ. The young and the well-cared-for individuals are usually exempt.

To realize to the fullest extent the possibilities of a given volume of muscular tissue to afford lodgment to trichinæ the observer must get an old slaughter-house rat, or at least one from some place where rats congregate in large numbers and feed on refuse animal tissues. Such a specimen was recently brought to the laboratory. A rat was in demand for the purpose of making observations on blood crystals; but the specimen procured turned out to be useless, the blood being scanty, of a peculiar ropy consistency, and having the color of powdered carmine instead of the rich scarlet color of normal

blood. On examination the muscles were found to be literally crowded with trichinæ. All muscular surfaces were distinctly granulated to the unaided eye, and under the microscope the parasites were found so closely crowded as practically to occupy the entire place. In some fields of the microscope there was not even a shred of a muscle visible — nothing but cysts bound together by a very scanty development of connective tissue. A large proportion of the cysts contained two or more worms. Three or four in one cyst was no uncommon occurrence, five were occasionally seen in the same sac, and in at least one instance observed a single cyst contained six trichinæ. By moistening the fresh tissue with normal salt solution and pressing a small piece of it somewhat vigorously between two slides, many of the cysts were ruptured and the worms set free. In the salt solution they could be kept active for an indefinite period, and the observer might have at any time a dozen or more of the free worms writhing and squirming in the field of his instrument.

The rat in question showed symptoms of being greatly enfeebled by its enormous burden of parasites; and it, with its fellows, exhibited signs of inordinate thirst. Water was more attractive than any other bait, and it was the desire for water that led to the capture of the specimen here described. This individual would certainly soon have fallen a victim to the appetite of its fellow rodents, and every morsel of its flesh would have been competent to inoculate thoroughly a large section of the muscine community. Such an individual tends to dispel all mystery regarding the manner in which rats, cats and swine obtain these dangerous parasites.

Rats abound in all close hog pens and are doubtless the chief means whereby trichinæ are perpetuated and transmitted to swine. The total annihilation of rats is probably out of the question, but I doubt not if they were exterminated the dangers to humanity arising from trichinæ would be immensely reduced if not altogether stamped out. So long as rats persist we may secure practical safety by selecting for food only

such swine as are reared and fattened under circumstances that preclude the visits of rats in any considerable numbers to their pens and feeding troughs. If sanitary legislation is ever to effect anything in preventing attacks of trichinosis this is the direction in which it must look. Systematic and concerted warfare on rats may do some good, but much more will be accomplished by preventing the sale of animals that have fed on offal or animal refuse of any kind, or animals that have been fattened in close quarters favoring the visits of large numbers of rats. The small pens are often a mere refuge and breeding place for rats. When swine are fed exclusively on grains or other vegetable products and reared and fattened in considerable numbers in comparatively large enclosures where there are no structures that would afford a harboring and breeding place for rats, then they may be exposed for sale on our local markets, or sent abroad to supply the markets of the world, with a high degree of confidence in their perfect wholesomeness so far as trichinæ are concerned. If packers and shippers handled only swine from farms, where the animals are prepared for market in large numbers, neither France nor Germany nor any other country would have occasion on sanitary grounds to enact prohibitive laws respecting the importation of American pork. When it is remembered that probably ninety-nine per cent. of the animals killed, by western packers at least are from farms, it will be seen that the danger from trichinæ to our foreign customers is ridiculously small. As it is the Americans take most of the risks themselves. The swine that have been kept for some months at our slaughter pens are disposed of in the local markets; the family hog, with all his possibilities for harboring parasites, goes into the private pork barrel. It is our best and cleanest that are sent abroad.

The risks that the Americans take are after all very small. In the very worst cases thorough cooking of the flesh obviates all possibility of danger, so that even if every animal were infested to its utmost capacity, it would be a rare thing for the

parasites to escape the effects of cooking, and enter the human body alive. If any one is barbarous enough to eat raw pork he must be prepared to take the consequences.

THE LŒSS AND ITS FOSSILS.

(CONTINUED.)

B. SHIMEK.

I. THE FOSSILS.

During the past summer the writer collected numerous specimens of Lœss fossils in eastern Nebraska and western Iowa, concerning which the following supplemental report may be of interest.

The species which were obtained in new localities, but do not in any way effect the general comparisons already made, except to emphasize what has already been said concerning each one, are the following:

Helicina occulta, Say. From Otoe, Douglas and Sarpy counties, Nebraska, and Pottawattamie county, Iowa.

Zonites radiatulus, Alder. Otoe county, Nebraska, and Pottawattamie county, Iowa.

Helicodiscus lineatus, (Say) Morse. Douglas county, Nebraska, and Fremont and Pottawattamie counties, Iowa.

Patula striatella, (Anth.) Morse. Sarpy and Otoe counties, Nebraska, and Fremont county, Iowa.

Stenotrema leaii, (Ward) Binn. Sarpy and Douglas counties, Nebraska, and Pottawattamie county, Iowa.

Vallonia pulchella, (Muell.) Binn. Otoe and Douglas counties, Nebraska, and Fremont and Pottawattamie counties, Iowa.

Ferussacia subcylindrica, (L.) Binn. Otoe county, Nebraska, and Pottawattamie county, Iowa.

Pupa armifera, Say. Douglas county, Nebraska, and Pottawattamie county, Iowa.

Pupa decora, Gld. Otoe county, Nebraska. These are a trifle below the average.

Pupa muscorum, L. Otoe county, Nebraska. These are like the Lancaster county specimens heretofore mentioned.

Pupa alticola, Ingersoll. Otoe county, Nebraska, and Fremont county, Iowa.

Vertigo gouldii, (Binn.) Stimp. Otoe county, Nebraska. These are precisely like the recent specimens from Iowa City, Iowa.

Succinea verrilli, Bland. Otoe county, Nebraska, and Fremont county, Iowa. This is connected with *S. avara* by large series of fossils, and seems to be a mere variety of the latter.

Succinea lineata, W. G. B. Otoe county, Nebraska, and Fremont county, Iowa.

Succinea obliqua, Say. The smaller, more slender form was collected in Sarpy and Otoe counties, Nebraska, and Fremont county, Iowa. Additional specimens from Douglas county, Nebraska, are like modern types.

Carychium exiguum, (Say) Gld. Otoe county, Nebraska.

Limnæa humilis parva, Lea. Otoe county, Nebraska. These specimens are at the lower extreme in size and development.

In addition to the foregoing, other species already reported upon were collected, but as they present additional interesting facts they are here given separately.

Zonites arboreus, Say. A much larger series of this species was obtained from Douglas, Otoe and Sarpy counties,

Nebraska, and Fremont and Pottawattamie counties, Iowa. These resemble average recent specimens from Iowa and Nebraska.

Zonites shimekii[1], Pilsbry. This was reported as *Z. limatulus*, Ward, though the propriety of considering it a distinct species was suggested by the writer in No. 1, Vol. I, p. 62 of this series. It certainly is not true *Z. limatulus* and should be stricken from the lists in the former article (pp. 210 and 214) in which comparisons are made with recent shells.

Additional specimens were collected in Otoe county, Nebraska, and Fremont county, Iowa.

Patula alternata, (Say) Binn. Specimens from Sarpy and Douglas counties Nebraska, fully equal recent average specmens from Iowa and Nebraska.[2]

Merodon multilineata, (Say) Try. Additional specimens of the small form were collected in Otoe county, Nebraska, and Pottawattamie county, Iowa. Specimens quite equalling average recent Iowa and Nebraska shells were collected in Sarpy and Douglas counties, Nebraska, and Pottawattamie county, Iowa. This increases the average size of the fossils so much that this species, as well as the foregoing, should be stricken from the list at the bottom of page 213 in the former article.

It will be observed that this additional evidence indicates even a less depauperate condition of the shells than was suggested in the former article.

In addition to these the following additional species, not reported in the former article, were collected:

Stenotrema hirsutum, (Say) Try. These are smaller than average recent specimens, but are precisely like recent speci-

1 For the description of this species see *The Nautilus*, Vol. IV., No. 1, May 1890.

2 Special care was exercised in this, as in all other cases, that bleached modern shells should not be taken for fossils. The vast majority of the fossils in the writer's collection were obtained by digging into undisturbed Lœss.

mens from Benton county, Iowa. The species now occurs throughout the eastern United States.

Mesodon albolabris, (Say) Morse. Two specimens were collected in Sarpy county, Nebraska. These are like average recent shells from Minnesota and Iowa, but smaller than eastern specimens. The species now ranges from Canada to Arkansas.

Mesodon profunda, (Say) Binn. Specimens were collected in Sarpy and Douglas counties, Nebraska, and Pottawattamie county, Iowa. They are like medium and small recent shells from Iowa. The species now occurs from Minnesota to Virginia.

Strobila labyrinthica, (Say) Morse. Only two specimens were collected in Pottawattamie county, Iowa. These are precisely like the recent specimens from Texas, but smaller than Iowa and Minnesota shells. It ranges now throughout the eastern portion of the continent.

Pupa fallax, Say. Specimens were taken in Fremont county, Iowa. These are like Ohio and Iowa recent shells. The species occurs from New England to Texas.

Pupa contracta, Say. But one specimen was taken in Pottawattamie county, Iowa. It is above the average in size, resembling large Iowa and Nebraska specimens. The species is now found throughout the eastern part of the continent.

According to their distribution these new species may be arranged as follows:

Mesodon profunda should be added to the list at the bottom of p. 210 in the former article, while the remaining species should be added to the list immediately preceding it. As to habitat *Pupa contracta* should be listed with *Z. arboreus*, *Z. minusculus*, etc., on p. 213 of the former article. The remaining species prefer damp, wooded places in the vicinity of streams. The presence of these latter shells in such small numbers would not interfere with our conception of the nature

of the Lœss surface as corresponding to our modern prairies, since the same species now sparingly occur in the narrow bands of timber along our prairie streams. In fact their presence only makes the similarity of the Lœss molluscan fauna to that of the modern prairies, taken as a whole, much more striking.

II. DISCUSSION AND CONCLUSIONS.

The presence of the boreal species[1], the prevalence of other rather northerly forms, the presence of the larger forms of *Zonites fulvus* and *Vallonia pulchella* (corresponding to larger specimens from high altitudes in Montana and Nevada), the abundance of *Helicina occulta*, which, though not boreal, now prefers cool, northern hillsides (to which it has probably retreated as a last resort in the limited localities in which it now occurs), and the stunted form of the species specially referred to, all indicate that the climate was then colder than at present[2], though its severity could by no means have been such that ice-bound lakes and streams could exist during the summer. The mingling of northern and middle latitude species would rather indicate a mean between the climate of the northern and that of the Interior Regions.

It is interesting to consider in this connection the extent of variation and degeneration which would be induced by a dry, as well as by a cold climate.

Certainly those who maintain that Baron Richthofen's theory (which presumes a dry climate) is applicable to the Lœss under consideration would find some support for their views in the occurrence of *Succinea lineata*, *Patula strigosa cooperi*, and *Pupa alticola*, which now seem to be dry-climate and

1 As already noted, *Pupa muscorum*, while a boreal species on this continent, is not so in the old world. This reduces the number of strictly boreal species.

2 This has already been suggested by McGee and Call in the *American Journal of Science*, Vol. XXIV., September, 1882. A comparison of large sets of both fossil and recent shells does not however admit of the degree of difference in climate there suggested.

high-altitude species, as well as in that of depauperate *Limnæa caperata* (resembling exactly the recent shells from Nebraska prairie ponds which often dry up), which are smaller and more slender than specimens from colder, moister regions far to the north.

The size and development of all of these forms must have been governed, as it is now, by the abundance of food and the length of the period of activity. The amount of food, as well as the length of the warm, moist period of activity would be less in a dry, as well as in a cold climate, and it is impossible to state definitely whether only one or both of these conditions were responsible for the observed variation, though the modern habits of some of the species indicate that we should not entirely ignore the former one of these conditions. On the other hand the smaller, heavier forms of *Mesodon multilineata* and *Succinea obliqua*, *Vertigo ovata*, the *Limnææ*, etc., are associated with an abundance or excess of moisture, and rather point to the presence of even more moisture than now occurs in the region under consideration. The great majority of the molluscs, however, indicate a climate at least as moist as that of this region, while the presence of boreal species points to a temperature somewhat below the present in average,—an opinion which is only strengthened by the wide distribution (especially in a northerly direction), and the great adaptability to climatic variations of the majority of the remaining species.

The climate was comparatively uniform during the entire period, if we may judge from the fossils, for the same forms are often found from the very base, just over the drift, to the uppermost portions of deposits one hundred feet or more in thickness. No difference is noticeable between specimens of the same species from the lowermost and the uppermost portions of the deposits,—a fact which warrants us in concluding that climatic changes during the deposition of the Lœss could not have been very great. The fact may here again be emphasized that while a depauperation is noticeable in some of

the species, it is far from sufficient to indicate a temperature such as would be necessary to retain lakes and streams within shores of ice during the summer, and that consequently the Lœss was not deposited during a glacial climate, but at a time when the temperature had moderated sufficiently to enable many land-shells, now restricted to or abundant in middle latitudes, to flourish in considerable numbers.

The great predominance of strictly terrestrial[1] species of molluscs in the Lœss indicate that during its deposition large areas of land-surface were exposed, at least during the greater part of the summer, upon which these molluscs lived and multiplied under conditions which exist now in the habitats of their modern representatives.

For the belief that the fossils as now found are not far removed from the localities in which they lived and developed, a number of valid reasons exist the most striking of which are the following:

1. *Their usually perfect preservation.* Such delicate shells as many of those under consideration could not be transported far by turbulent streams without being broken.

2. *Their distribution, both vertically and horizontally.* In many exposures of the Lœss the species which to-day have the habit of remaining in considerable numbers in very restricted localities, as *Helicina occulta*, *Patula strigosa cooperi*, *Mesodon multilineata*, the *Limnææ*, etc., are likewise similarly restricted in their horizontal distribution to very narrow "pockets," though the same species may often be traced ver-

1 In the *Sketches of the Physical Geography and Geology of Nebraska*, pages 277–290, Prof. Aughey gives a long list of Lœss fossils, in which are included forty-two aquatic species, quite a number of them being fluviatile. These are not taken into consideration here, because, while Prof. Aughey is a close observer and an able geologist, there is no doubt that many of his identifications of these fossils were erroneous. His method of identifying many of them (*i. e.* by making sections) as given on p. 287 will at once convince anyone familiar with such genera as *Zonites*, *Helix*, *Succinea*, *Physa*, etc., of the unreliability of the entire list. It is extremely difficult to identify many of the species there listed even from perfect recent specimens.

tically for many feet, as though the shells had gradually accumulated through many generations. Again other species are more generally and more uniformly distributed in a manner which recalls their present habits, and which indicates that they have not drifted into the places in which we find them to-day,—at least not sufficiently far to disturb the arrangement with reference to each other, which we may observe in the living specimens.

Drifted shells are usually either thrown upon the banks of streams in comparatively large numbers, where they then occur in narrow bands, or, if too heavy to float, they are dropped long before such fine sediment as that which composes the beds in which these fossils occur. Neither the horizontal nor the vertical distribution indicate that these shells had been removed to any considerable distance from their original locations. The view which has been advanced by the majority of those who have worked upon the Lœss of the Mississippi and the Missouri (*i. e.* Owen[1], White[2], Todd[3], Aughey[4], McGee[5], Witter[6], etc.) is that it was deposited in large lakes or lake-like expansions of rivers. While the homogeneity and the occasional lamination of the Lœss indicate a sub-aqueous origin, the character and distribution of the fossils combat the idea of large bodies of water existing during the summer—the growing-period of the molluscs.

The writer's conception of the climate and of the origin of the Lœss, based largely upon a careful and extended study of its fossils, may be briefly summarized as follows:

I. The summers during the formation of this deposit were

1 On the authority of the following.

2 *Report of the Geol. Sur. of the State of Iowa*, by C. A. White, M. D. Vol. I., 1870.

3 Prof. J. E. Todd in the *Proc. of the A. A. A. S.*, Vol. XXVII., 1878.

4 *Sketches of the Phys. Geog. and Geol. of Nebraska*, by Prof. S. Aughey, 1880.

5 *Am. Jour. of Science*, Vol. XXIV., Sept., 1882. W. J. McGee and R. Ellsworth Call.

6 *Notes on the Lœss*, by F. M. Witter.

comparatively warm, and the glaciers had already retreated far to the north when the deposition commenced.

II. During at least a part of the summers a large portion of the area now covered by the Lœss was elevated above the surface of water, as indicated by the presence of the predominating land shells.

III. These shells, too, indicate that the surface was not entirely unlike our present prairies in Iowa and Nebraska, though perhaps more moist, and more nearly level.

IV. The presence of shells of the genera *Limnæa*, *Physa*, *Planorbis*, and *Pisidium*, which are principally pond species, indicates that over this prairie surface were scattered numerous ponds and that it was traversed by quiet, sluggish streams.[1]

V. The distribution of the shells as well as the homogeneity and fineness of the material forming the deposit indicate that the deposition was unaccompanied by violent disturbances, but that it took place quietly, and very slowly during a long period.

VI. The deposit itself was probably partly formed from sediment carried over portions of the surface by quiet overflows of the sluggish streams which had not yet deeply cut their channels.[2] The numerous ponds, however, fed by the drainage in their immediate vicinity, were also receiving with this the finer material gathered from the glacial drift surrounding them.[3] This material, being like that gathered by

1 This is all the more plausible if we add the fresh-water shells reported from the Lœss of the Missouri by Prof. Swallow. The additional genera reported by him are *Valvata*, *Amnicola* and *Sphærium*, and these, too, are most commonly found in ponds and sluggish streams.

2 This idea has already been suggested by James E. Mills in the *American Geologist*, Vol. III., No. 6, and also by Warren Upham (in the *9th Annual Report of tha Geol. and Nat. His. Survey of Minn.*) and others, but the extent, duration, and violence of the flood suggested by the latter are entirely incompatible with the facts presented in this paper.

3 The existence of ponds directly in or upon the sand and pebbles of the glacial drift is not remarkable, or extraordinary. In the "Sand Hills" of Nebraska hundreds of ponds are now found in the sand, the fine sediment at the bottoms of which alone seems to prevent their draining away through the sand.

the streams, would form similar deposits, each pond or swamp forming in this way a bed of Lœss. The changes in the level of water in the ponds would produce a change in the extent of the muddy flats along their shores, thus facilitating the distribution of the terrestrial shells. These ponds and streams, by shifting about through the combined influence of floods and drouths, extended the distribution of the sediment, and subsequent erosion completed the work necessary to produce the present topography.

In this way we can best account for the remarkable differences in the level of the base of the Lœss deposits, which has always been a stumbling-block to those who maintain that the deposit was formed in large lakes. The ponds, not being at the same level, and each being a center of formation, would naturally produce a combination of deposits, the bases of which would be at different levels. Even near the tops of ridges ponds could bodily lift themselves upward by slowly filling up, each successive deposit during flood-time in rainy seasons bringing both the bottom and the shores higher.

It is quite probable that a deposition of material is going on in the same manner to-day in the ponds of the Thousand-lakes region of Minnesota and Iowa, and the Sand Hills region of Nebraska.

Of these conclusions the sixth is the least clearly defined, and is offered here merely as a suggestion. The presence of Lœss on the very tops of hills would of course be a serious objection to a portion of it, unless we make a great allowance for erosion. It does seem clear however that all of the Lœss in any given region could not have been deposited by the same agency (*i. e.* one stream or a single large lake) but that it is rather composite in its origin.

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IOWA CITY, IOWA:
June, 1892.

Secretary WM. J. HADDOCK:

We take pleasure in submitting herewith Bulletin No. 2, of Volume II, from the Laboratories of Natural History, State University of Iowa.

THE EDITORS.

THE MYXOMYCETES OF EASTERN IOWA.

THOMAS H. McBRIDE.

The Myxomycetes or Slime-moulds include certain very delicate and extremely beautiful fungus-like organisms common in all the moist and wooded regions of the earth. Deriving sustenance, as they for the most part do, in the decomposition-products of organic matter, they are usually to be found upon or near decaying logs, sticks, leaves and other masses of vegetable detritus, wherever the quantity of such material is sufficient to insure continuous moisture. In fruit, however, as will appear hereafter, Slime-moulds may occur on objects of any and every sort. Their minuteness retires them from ordinary ken; but such is the extreme beauty of their microscopic structure, such the exceeding interest of their life-history, that the enthusiastic student who has once discovered and recognized the group is apt to seek widely and to forget all else in the pursuit. In Iowa, and indeed in all the Mississippi valley the Slime-moulds have been little studied. Beyond the enumeration of a few species in the plant lists of isolated localities, there has been no serious attempt to give any account whatever of this section of our biologic world. It is hoped that the present paper though mainly preliminary, may yet provoke more careful collection and contribute to a profounder investigation of these unnoticed organisms, in some respects, at least, the most interesting and remarkable that fall beneath our lenses.

the plasmodium is hardly entitled to be called a cellular organism; its only claim, the possession in certain cases of numerous nuclei as stated above. In passing now into the condition of rest, the whole protoplasmic mass separates simultaneously into numerous definite polyhedral or parenchymatous cells, each with a well developed *cellulose wall*. When the conditions essential to activity are restored, the walls disappear, the cellulose is resorbed, and the plasmodium resumes its usual habit and structure.

The plasmodial phase of the Slime-mould, like the hyphal phase of the fungus, may continue a long time; for months, possibly for years. The reason for making the latter statement will presently appear. But however long or short the plasmodial phase continue, the time of fruit, the reproductive phase at length arrives. When this time comes, induced partly by a certain maturity in the organism itself, partly no doubt by the trend of external conditions, the plasmodium no longer as before evades the light, but pushes to the surface, and appears usually in some elevated or exposed position, the upper side of the log, the top of the stump, the upper surface of its habitat whatever that may be; or even leaves its nutrient base entirely and finds lodging on some neighboring object. In such emergency the stems and leaves of flowering plants are often made to serve, and even fruits and flowers afford convenient resting places. The object now to be attained is not the formation of fruit alone, but likewise its speedy dessication and the prompt dispersal of the perfected spores. Nothing can be more interesting than to watch the Slime-mould as its plasmodium accomplishes this its last migration. If hitherto its habitat has been the soft interior of a rotten log, it now begins to ooze out in all directions, to well up through the crevices of the bark as if pushed by some energy acting in the rear, to stream down upon the ground, to flow in hundred tiny streams over all the region round about, to climb all stems, ascend all branches, even leaves and flowers to the height of many inches, all to pass suddenly as if by magic

charm into one wide-spread, dusty field of flying spores. Or, to be more exact, whatever the position ultimately assumed the plasmodium soon becomes quiescent, takes on definite and ultimate shape which varies greatly, almost for each species. Thus it may simply form a flat cake-like mass, *æthalium*, internally divided into an indefinite number of ill-defined spore-cases (sporangia); or the plasmodium may take the form of a simple net, *plasmodiocarp*, whose cords stand out like swollen veins, whose meshes vary both in form and size; or more commonly the whole protoplasmic mass breaks up into little spheroidal heaps which may be sessile directly on the substratum, or may be lifted up on tiny stems (stipitate), which rest in turn upon a common sheet-like film spreading beneath them all, the *hypothallus*. In any case, each differentiated portion of the plasmodium, portion poorly or well defined, elongate, net-like, spheroidal, elliptical or of whatever shape, becomes at length a sporangium, spore-case, receptacle for the development and temporary preservation of the spores.[1] The Slime-moulds were formerly classed with the gasteromycetous fungi (puff-balls), and in description of their fruiting phase the terms applicable to the description of a puff-ball, are still employed, although it will be understood that the structures described are not in the two cases homologous; only analogous. The sporangium of the Slime-mould, exhibits usually a distinct *peridium* or outer limiting wall which is at first continuous, enclosing the spores and their attendant machinery, but at length ruptures, irregularly as a rule, and so suffers its contents to escape. The peridium may be double, varies in texture, color, persistence and so forth, as will be more fully set forth in the several specific descriptions. The peridium blends with the hypothallus below when such structure is recognizable, either directly, when the sporangium is sessile, or by the intervention of a *stipe*. The stipe may be hollow, may contain coloring matter of some sort, or may even contain peculiar spore-like cells or spores; is often fur-

1 See however *Ceratiomyxa*, p. 114 following.

rowed, and in some cases shows a disposition to unite or blend with the stalks of neighboring sporangia. In many cases the stipe is continued upwards, more or less definitely into the cavity of the sporangium, and there forms the *columella*, sometimes simple and rounded like the analogous structure in *Mucor mucedo*, sometimes as in *Comatricha* branching again and again in wonderful richness and complexity.

Each sporangium is at maturity filled with numerous unicellular spores. These are usually spherical, sometimes flattened at various points by mutual contact; they are of various colors, more commonly yellow or violet brown, are sometimes smooth (?) but generally roughened either by the presence of minute warts, or spines, or by the occurrence of more or less strongly elevated bands dividing reticulately the entire surface. The spores are in all cases small (.003–.020 mm.) and reveal their surface characters only under the most excellent lenses. Associated with the spores in the sporangium occurs the *capillitium*. This consists of most delicate thread or hair-like elements, offering the greatest variety both in form and structure. The threads composing the capillitium are not to be regarded, even when free, as cells, nor even of cellular origin; they are on the other hand in such a case, simply shreds and strands of the original plasmodium, portions that have not been used in the formation of spores and are accordingly modified in such wise as to be useful in spore dispersal. The capillitium threads may be solid or hollow, they may occur singly or be combined into a net, they may be terete or flat, attached to the peridial wall or free, simple or adorned with bands or spires and knobs in every variety, uniform or profusely knotted and thickened at intervals, and burdened with calcic crystals. In many cases, as remarked, the capillitium contributes materially to the dispersal of the spores; in others, it doubtless contributes mechanically to the support of the peridial wall and renders so far persistent the delicate sporangium. For more exact description the reader is again referred to the specific delineations which follow.

The transition from phase to phase requires, as intimated, no great length of time. *Tilmadoche gyrocephala* completed the transition from vegetative to fruiting phase in less than 18 hours.

The germination of the spores ensues closely upon their dispersal or maturity and is unique in many respects. The wall of the spore is ruptured and the protoplasmic content escapes as a zöospore indistinguishable so far from an amœba, or from the zöospore of our Chytridiaceous fungi. This amœboid zöospore is without cell-wall, changes its outline, and moves slowly by creeping or flowing from point to point. At this stage many of the spores assume each a flagellate cilium and so acquire power of more rapid locomotion. The zöospores whether ciliate or not thus enjoy independent existence and are capable of continuing such existence for some time, assimilating, growing, and even reproducing themselves by simple fission, over and over again. This takes place, of course, only in the presence of suitable nutrient media. In the course of time, usually not more than two or three days (Zopf), the swarm-spores cease their activity, lose their cilia and come to rest, exhibiting at most nothing more than the slow amœboid movement first referred to. In the course of two or three days more, the little spores begin to assemble and flow together; at first into small aggregations, then larger, until at length all have blended in one large creeping protoplasmic mass to form thus once again the plasmodium, or plasmodial phase with which the round began.

With such a life-history as that thus briefly sketched, it is small wonder that the taxonomic place of the Slime-moulds is a matter of uncertainty, not to say perplexity. So long as men studied the ripened fruit, the sporangia and the spores, with the marvellous capillitium there seemed little difficulty; the Myxomycetes were fungi, related to the puff-balls, and in fact to be classed in the same natural order. The synonomy of some of the more noticeable species affords a very interesting epitome of the history of scientific thought in this par-

ticular field of investigation. Thus the first described Slime-mould identifiable by its description is *Lycogala epidendrum* (Buxb.) the most puff-ball-looking of the whole series. Ray, in 1690, called this *Fungus coccineus*. In 1718, Ruppius described the same thing as *Lycoperdon sanguineum;* Dillenius at about the same time, as *Bovista miniata*, and it was not until 1729, that Micheli so far appreciated the structure of the little puff-ball as to give it a definite generic place and title, *Lycogala globosum*. But Micheli's light was too strong for his generation. As Fries one hundred years later quaintly says: "* * * * immortalis Micheli tam claram lucem accendit ut successores proximi eam ne ferre quidem potuerint." Notwithstanding Micheli's clear distinctions, he was entirely disregarded, and our little Lycogala was dubbed *Lycoperdon* and *Mucor* down to the end of the century; and so it was not till 1790 that Persoon comes around to the standpoint of Micheli and writes *Lycogala miniata*. Fries himself reviewing the labors of his predecessors all, grouped the Slime-moulds as a sub-order of the Gasteromycetes and gave expression to his view of their nature and position when he named the sub-order *Myxogastres*. In 1833, Link[1] having more prominently in mind the minuteness of most of the species collocated by Fries, and perceiving perhaps more clearly even than the great mycologist the entire independence of the group, suggested as a substitute for the sub-order *Myxogastres*, the order *Myxomycetes*, *Slime-moulds*. Link's decision passed unchallenged for nearly thirty years. The Slime-moulds were set apart by themselves; they were fungi without question and, of course, plants.

If the hypha (See Bulletin Lab. Nat. Hist. Vol. I, p. 32.) is the morphological test of a fungus, then it is plain that the Slime-moulds are not fungi. No myxomycete has hyphæ nor indeed anything at all of the kind. Nevertheless there are certain parasitic fungi, (*Chytridiaceæ*) whose relationships

1 Raunkiær, *Myxomycetes Daniæ*, p. 7, shows that Link and not Wallroth as usually supposed, is entitled to this honor.

plainly entitle them to a place among the hyphate forms, that have no hyphæ whatever in the entire round of their life-history. These are, however, exceptional cases and really do not bear very closely on the question at issue.

Physiologically the fungi are incapable of independent existence, being destitute of chlorophyl. In this respect the Slime-moulds are fungi; they are nearly all saprophytes and absolutely destitute of chlorophyl. Unfortunately this physiological character is identically that one which the fungi share with the whole animal world, so that the startling inquiry instantly rises, are the Slime-moulds plants at all? Are they not animals? Do not their amœboid spores and plasmodia ally them at once to the amœba and his congeners, to all the monad, rhizopodal world? This is the position suggested by De Bary in 1858, and adopted since by many distinguished authorities among whom may be mentioned Saville Kent, of England, and Dr. Wm. Zopf, of Germany, (*Die Pilzthiere* 1885). Rostafinski, who was a pupil of De Bary's, and whose monograph on the Slime-moulds (1873) must forever remain a classic in scientific literature, adopts the title "Mycetozoa," suggested by his master as indicating a closer relationship with the animal world, but really has little to say in regard to the matter.

Dr. Schrœter, a recent writer on the subject, after showing the probable connection between the phycochromaceous Algæ and the simplest colorless forms, namely the Schizomycetes, goes on to remark: "At the same point where the Schizomycetous series take rise, there begin certain other lines of development among the most diminutive protoplasmic masses. * * * Through the amœbæ one of these lines gives rise on the one hand to rhizopods and sponges in the animal kingdom, on the other to the *Myxomycetes* among the fungi."[1]

1 In the quotation the present writer has aimed to give the sense rather than an exact translation.

From the fact that Dr. Schrœter still includes the Slime-moulds in his account of the fungi of Silesia and contributes a description of the same organisms to Engler and Prantl's "Pflanzenfamilien," we may conclude that to Dr. Schrœter, at least, Slime-moulds are plants.

Confirmatory of this view we may now call attention to one or two facts which the foregoing description has already brought to light. In the first place the formation of *cellulose* cell-walls in the case of the resting plasmodia is certainly not suggestive of the animal kingdom, the Tunicates to the contrary notwithstanding. Again, although, as has been said, the reproductive apparatus as a whole is not homologous with similar structures among the fungi, yet the formation of spores is entirely consistent with plant behavior; and the subsequent coalescence of the individual swarm-spores is not unlike the assembling of similar motile cells in the *Hydrodictyeæ* confessedly plants. This resemblance is the more suggestive if we take into account the acrasic forms (*Acrasieæ*) described by Brefeld, in which the amœboid bodies do not blend or fully coalesce to form the plasmodium but simply associate them selves together (aggregatplasmodium).

The fact is, the Myxomycetes constitute an exceedingly well defined group and anything we may say as to their relationships in either direction is in the light of present knowledge, problematical. Dr. Zopf's association of the Slime-moulds and monads appears forced, at best; and when it comes to the consideration of the former, their systematic and even morphological treatment, he is compelled to deal with them by themselves under headings such as "Eumycetozoen," "Höhere Pilzthiere," etc. One rather commends the discreetness of the lamented De Bary, whose painstaking investigations first called attention to the uncertain position of the group. After reviewing the results of all his labors De Bary does not quite relegate the Slime-moulds to the zöologist for further consideration but simply says (Mycetozoa, 1873); — "From naked amœbæ, with which the Mycetozoa (= *Myxomycetes*) are connected

in ascending line, the zöologists with reason derive the copiously and highly developed section of the shell-forming Rhizopoda, * * * And since there are sufficient grounds for placing the rhizopods outside the vegetable and in the animal kingdom, and this is undoubtedly the true position for the amœbæ, which are their earlier and simpler forms, the Mycetozoa, which may be directly derived from the same stem are at least brought very near to the domain of zöology."

Notwithstanding all the controversy in regard to the matter, the study of the Slime-moulds still rests chiefly with the botanists. The latest and simplest scheme of classification for the Thallophytes is that offered by Gœbel as follows:

THALLOPHYTA:
- I. Myxomycetes.
- II. Diatomaceæ.
- III. Schizophyta—includes the *Schizomycetes* and *Cyanophyceæ*.
- IV. Algæ, excluding Diatoms and *Cyanophyceæ*.
- V. Fungi, exclusive of *Myxomycetes* and *Schizomycetes*.

This arrangement commits us to no theory and enables us to study together those forms which by common consent are naturally associated.

About 400 species of Slime-moulds have been described. Saccardo enumerates 443, inclusive of those denominated doubtful or less perfectly known. These 443 species are distributed among 47 genera of which 15 are represented by but a single species each, (monotypic). In the United States there have been recognized about 150–200 species. Doubtless subsequent investigation will reduce the number rather than increase it. Of the species described, some are almost worldwide in their distribution, others are limited to comparatively narrow boundaries. The greater number occur in the temperate regions of the earth, although many are reported from

the tropics and some even from the arctic zone. Schrœter found *Physarum cinereum* at North Cape. Our Iowa forms are most numerous in the eastern, that is the wooded regions of the state. I have, however, found *Physarum cinereum* on the untouched prairie, as also *Physarum contextum* on the decaying stems of *Calamagrostis*.

As to the economic importance of our Myxomycetes there is no long chapter to write. The kindly Fries who has a good word to say for almost every living thing, says: "Usu in vita communi parum admodum sese commendant, sed in œconomia naturæ certe non spernendi. Multa insectorum genera ex eorum sporidiis unica capiunt nutrimenta." However this may be, there is one species which has come to light since Fries' day which is the source of no inconsiderable mischief to the agriculturist. *Plasmodiophora brassicæ* occasions the disease known as the "club-root" in cabbage and has recently been made the subject of special discussion in the *Journal of Mycology*.[1] Further than this; if *Plasmodium malariæ* be indeed a Slime-mould, and be as is alleged, the promoting cause and agent in malarial fever, then the group entire suddenly springs to most unusual interest in the attention of all mankind.[2] Aside from the injurious tendencies possible or real of these two, I know not that all other Slime-moulds of all the world, taken all together, affect in any slightest measure the hap or fortune of man or nation. And yet, if in the economic relations of things, man's intellectual life is to be considered, then surely come the uncertain Slime-moulds, with their fascinating problems, proffered still in forms of unapproachable delicacy and beauty, not without inspiration.

The Myxomycetes are defined and sub-divided as follows:

1 See Journal of Mycology, Washington, D. C., Vol. VII, No. 2.

2 See *inter al.* U. S. Senate Misc. Doc., Report on Cholera in Europe and India, p. 688, et seq.

CLASS[1] MYXOMYCETES, *Link.*

Chlorophyl-less organisms whose vegetative phase consists of a naked mass of protoplasm, the *plasmodium;* reproduced by spores which are either free or enclosed in sporangia, and which on germinating produce ciliated or amœboid zöospores whose coalescence gives rise to the plasmodium.

The Myxomycetes are either:—

A. *Parasites* in cells of living plants, ... PHYTOMYXINÆ.
B. *Saprophytes*, when they exhibit diverse plasmodia;
  a. Plasmodium of imperfectly united spores, . . . ACRASIEÆ.
  b. Plasmodium of spores completely blended, MYXOGASTERES.[2]

Of these three sub-orders the *Acrasieæ* are the simplest, but are so far unknown to our collection.

ORDER PHYTOMYXINÆ, Schrœter.

The parasitic Myxomycetes include but few (four or five) species, distributed among four genera. They are all (?) parasites in the cells of living plants; their vegetative phase is plasmodial and their spores are formed by the simultaneous breaking up of the plasmodium into an indefinite number of independent cells. But a single genus need here concern us;

PLASMODIOPHORA, *Woronin.*

Parasitic in the parenchymatous cells of the roots of living plants: causing noticeable enlargement of the affected organ, producing at length galls, knots and various deformities and distortions. Spores spherical, smooth, colorless, .016 mm.

1 The term class is employed here for sake of symmetry. I have no quarrel with him who prefers some other taxonomy.

2 So Dr. J. Schrœter in Engler and Prantl's Natürlichen Pflanzenfamilien: Myxomycetes. The present systematic outline is substantially his, modified to suit the present purpose.

1. PLASMODIOPHORA BRASSICÆ, *Woronin.*

This species, the only one so far reported in this country, infests the roots of cabbages, and produces a very serious disease of that vegetable. In England the malady has long been known under the names "clubbing," "fingers and toes," etc. The roots affected swell greatly and at length resemble sometimes the flexed fingers of the human hand, hence the English name. As the disease progresses the roots speedily rot away to the serious injury of the leaf-bearing portion of the plant. In badly affected fields, sometimes one-half of the crop is utterly destroyed. Careful search continued through several years has not availed to bring this species to my personal acquaintance.

In the *Journal of Mycology*, Vol. VII, No. 2, Mr. Eycleshymer, writing on this subject, gives Iowa as a locality for *Plasmodiophora brassicæ.* Further authority for the statement is not given. It may be said, however, that the occurrence of the parasite within our limits is not known to the authorities at our Agricultural College or at the Experiment Station.

ORDER MYXOGASTERES,[1] *Schrœter.*

(MYXOMYCETES proper.)

Saprophytic Slime-moulds. So far as known the spores in germination give rise to zöospores, at first ciliate (cilium single) later amœboid, which are capable of continued independent existence, increase by fission, and finally coalesce to form the plasmodial phase. The fruiting phase presents abundant minute unicellular spores, either exposed, or enclosed in sporangia. In the latter case the spores are more frequently attended by thread-like structures, the capillitium.

1 Fries described all the Slime-moulds known to him (*Syst. Mycol.* Vol. III.) under the sub-order *Myxogastres*, order Gasteromycetes; Schrœter, as above.

KEY TO THE FAMILIES OF THE MYXOGASTERES.

I. Spores not included in sporangia, ... CERATIOMYXACEÆ.
(*Exosporeæ*, Rostafinski.)

II. Spores included in sporangia.
(*Endosporeæ*, Rostafinski.)

A. Capillitium wanting.

1. Peridium simple, breaking irregularly, . . LICEACEÆ.
2. Sporangia uniting to form æthalia, inter-communicating laterally, or on all sides, . . . CLATHROPTYCHIACEÆ.
3. Sporangia single with net-like thickenings, CRIBRARIACEÆ.

B. Capillitium present.

1. Fruit free from deposits of lime.
   a. Columella none; threads of capillitium tubular, TRICHIACEÆ.
   b. Columella prominent (usually); capillitium not tubular; spores violet-tinted.
   * Sporangia in æthalia; spores brown, RETICULARIACEÆ.
   * * Sporangia distinct; spores violet tinted, STEMONITACÆ.
2. Fruit with calcareous deposits.
   a. Capillitium with lime *crystals* or free from calcareous deposit.
   * Capillitium without lime; columella present, SPUMARIACEÆ.
   * * Capillitium with crystals, if lime be present, no columella, . . . DIDYMIACEÆ.
   b. Capillitium containing lime in amorphous grains, PHYSARACEÆ.

I. CERATIOMYXACEÆ.

Sporangia none. Spores superficial, borne on erect papillæ, or even on the walls of minute depressions or pits; each spore surmounting a delicate pedicel or stalk. The spores on germinating give rise to amœboid zöospores which undergo repeated divisions, later become ciliate, and at length again amœboid to blend into genuine plasmodia. At maturity the plasmodium gives rise to numerous minute divisions, each of which may lengthen in a direction perpendicular to the surface and bear a spore at the tip.

CERATIOMYXA, *Schrœter.*

(*Ceratium*, Albertini and Schweinitz.)

Plasmodium in rotten wood, white or nearly transparent; when fruiting, forming on the substratum mould-like patches composed of the minute sporiferous pillars, generally in clusters of three or more together.

2. CERATIOMYXA MUCIDA, *Persoon.* Plate I, Figs. 7 and *7a.*

(*C. hydnoides*, Alb. and Schw.)

Rather rare, but occuring in summer on shaded rotten logs, especially after warm showers and in sultry weather. Easily distinguishable from all similar moulds by the absence of mycelium or of anything like a hypha.

II. LICEACEÆ.

Fruit consisting of distinct sporangia, plasmodiocarps or æthalia. Peridia membranaceous, without reticulate thickenings, opening irregularly at maturity. Capillitium none.

KEY TO GENERA.

Fruit consisting of distinct sporangia, or plasmodiocarpous; spores brown, ... LICEA.

Fruit of many united sporangia.

a. Single sporangium prismatic, long tube like, . . . TUBULINA.

b. Single sporangia very short, cell-like, at maturity no longer individually distinguishable, ... LINDBLADIA.

TUBULINA, *Persoon.*

Sporangia cylindric, or by mutual pressure prismatic, fasciculate, unitedly forming a large æthalioid mass, resting upon a strongly developed, sometimes columnar, hypothallus.

3. TUBULINA CYLINDRICA, *Bulliard.* Plate I, Fig. 4, and Plate VII, Fig. 8.

Sporangia united into a single cluster or in lesser gregari-

ous clusters, cylindrical, sometimes nearly half a centimeter high, rounded at the apex, slightly iridescent. Spores rusty brown, spherical, finely warted, .0075.[1] July—September.

The spores are described as minutely or delicately verruculose; when very highly magnified, they appear to me netted. The same impression is given when the spore is examined under a magnification of even 600 diameters, if the lens be good. On moss patches. Not common.

LINDBLADIA, *Fries.*

Æthalium naked, formed of the irregularly polygonal coalescent sporangia. The outer walls of the outer peridia unite to form a common covering, generally papillose.

4. LINDBLADIA EFFUSA, *Ehrenberg.* Plate I, Figs. 3 and 3*a*.

Æthalium naked, seated upon a common strongly developed hypothallus, spread in an ochraceous or olive-tinted mass, sometimes covered with a pitch-black, shining papillate crust. Spore-mass ochraceous-brown, the spores spherical, bright-colored, smooth.

Following N. A. F. No. 1700, I have referred our Iowa material to this species though not without serious misgivings. The description given above from Rostafinski is not specially applicable in several important particulars. In the first place in our forms the plasmodium gives rise not to a true æthalium but to a single series of sporangia whose peridia at maturity *remain distinguishable*, are *not* covered by a common investment, but exhibit quite as much individuality as the similar structures in *Tubulina*. Mr. A. P. Morgan (in litt.) avers the identity of our material with *Perichæna cæspitosa*, Pk. (Rep. State Museum, 31, p. 75) and suggests the name *Tubulina cæspitosa*, Pk., as recording the proper disposition of the case.

1 All spore measurements will be understood as indicating so many thousandths of a millimeter.

I have also from Dr. Morgan a specimen which he designates *Lindbladia effusa*, Ehr., which certainly corresponds much better to descriptions given in the various texts at my disposal, especially in that it forms an undoubted æthalium, in which the individual sporangia lose their identity. Nevertheless the spores in the two cases are identical as to surface, and of the same size; the peridia of the same general texture, color (en masse), etc.

The plasmodium of which I here collected the fruit was widely effused, covering with a rather tough papyraceous sheet (the hypothallus) the side of a log for many inches (six by twenty-three). It was quite mature when first discovered and has not re-appeared, so that its earliest history remains unknown.

This is one of the numerous instances which go to show that the Slime-moulds, or even ordinary fungi for that matter, are by no means annuals. Some are; but most appear in a given locality, all things favoring, only at long intervals which cover doubtless several or many years.

III. CLATHROPTYCHIACEÆ.

Sporangia united to form æthalia; the walls thickened in certain places, at maturity vanishing except where thickened.

KEY TO THE GENERA.

Walls of the mature sporangia perforate on every side, . . ENTERIDIUM.
Mature sporangia prismatic, only the apex permanent; the vertical angles like descending threads, ... CLATHROPTYCHIUM.

ENTERIDIUM, *Ehrenberg*.

Sporangia in the mature æthalium inextricably confused, and individually indistinguishable, covered by a thin cortex. The remains of the peridia after the escape of the spores resembling a net.

5. ENTERIDIUM ROZEANUM, *Wingate.* Plate I., Figs. 1, 1*a* and 1*b*.

Æthalium, irregular, hemispherical, two to five centimeters broad, brown, covered at maturity with a thin transparent shining cortex, which blends below with the expanded hypothallus. The united walls of the peridia forming a translucent net, by reason of the numerous perforations or openings between the several sporangia. Spores .008, brown, developed in clusters, hence exhibiting a varied surface as in *Reticularia.* Sculpture, when examined under high magnification, net-like, over about two-thirds of the surface.

One of the largest and most conspicuous species of the group. Specimens are also from year to year quite common, very pretty, shining and trim, as they rest upon their substratum of rotten wood. Later in the season when the spores have all been blown away, the papery white cortex remains in shreds behind, covering the residua of the ragged peridia. When highly magnified (1000–1400 diameters) the spores exhibit an elegant net-like reticulation spread over the larger part of the surface. In several particulars, external appearance, size and markings of the spores, this species resembles *Reticularia lycoperdon* with which it is generally confused. The capillitium, however, instantly distinguishes the two, and in the present form the spore-sculpture is more delicate.

CLATHROPTYCHIUM, *Rostafinski.*

Sporangia, sessile, cylindric or prismatic, close-packed in a single stratum, forming a flat disk-like æthalium one or two centimeters broad. The peridium at maturity vanishing except the polygonal dome-like apex which is attached by a few simple filaments descending from the angles to the hypothallus.

6. CLATHROPTYCHIUM RUGULOSUM, *Wallroth.* Plate I, Figs. 2, 2*a* and 2*b*.

Hypothallus strongly developed, usually extending beyond

the base of the fruiting plasmodium on all sides. Sporangia erect, prismatic, hexahedral. Æthalium, olive or lead-colored, roughened by the arched apices of the numerous peridia. Spores ochre or ochre-brown, delicately warted, .007–.012.

An elegant and most peculiar species; perfectly finished, firm, constant and happily not rare. The hundreds of tiny sporangia packed so closely together might deceive the inexperienced collector and be mistaken for the fruit of *Trichia chryrosperma*, but the first glimpse of the dainty architecture which the lens reveals is sufficient for immediate recognition. Habitat; moist stumps and twigs in the denser woods.

IV. CRIBRARIACEÆ.

Sporangia, single, isolated and generally stalked. Peridia with net-like thickenings which persist, the unthickened portions disappearing at maturity.

KEY TO THE GENERA.

Thickening of the peridium scalariform from base of the sporocyst to apex, ... DYCTIDIUM.
Thickenings reticulate, lace-like, ... CRIBRARIA.

DICTYDIUM, *Schrader.*

Sporangia, separate, stalked, about two millimeters high and half a millimeter wide. The radiate veins of the peridia parallel and equal, meridional, connected by very delicate transverse threads forming rectangular meshes. At maturity the walls of the peridium except where thickened vanish, leaving a basket-like structure filled with spores.

7. DICTYDIUM CERNUUM, *Persoon.*

Sporangia numerous, small, rather long-stalked, nodding, at first almost black, violet, then purple-brown; the spore-case oblate or more or less depressed above, especially when mature. Spores brown, smooth, .004–005. July—August.

This most dainty little species is so perfectly differentiated as scarcely to need further description. The deep red plasmodium at first sends up the columnar stipe, up which the plasma creeps, swells into a tiny sphere which forms peridial wall and spores, with all the delicate tracery of the net, as if by simple dessication. Year after year it re-appears in almost the same locality. An old decadent apple-stump affords at once nutrition and protection, and there, after some summer shower the fortunate observer may witness, even in the course of a single day, a transformation rare.

The species has a wide range, extending from Iowa to Ceylon, and would seem cosmopolitan. The wood of various conifers, however, is said to afford a habitat preferred, and the range is probably conterminous with the coniferous forests of the globe.

CRIBRARIA, *Persoon.*

Sporangia, separate, generally stalked. Peridia persistently cup-shaped below, above affected by reticulate thickenings which give rise at length to an overarching net of various rather large polygonal meshes.

8. CRIBRARIA INTRICATA, *Schrader.* Plate I, Figs. 5, 5*a* and 5*b*.

Sporangia stalked, globular, pale ochre or yellowish-brown; stem subulate, tapering upwards, expanded above into the shallow cup-like serrated base of the peridium, the so-called "receptacle." The net with strongly developed polygonal nodes, joined by delicate threads two or more in number, persisting. Spores pale, .006–.007, the surface slightly roughened.

A rather common species occurring on all sorts of habitats, rotting stumps, logs, pine boards, fences, etc. The isolated sporangia are sometimes very numerous, distributed over an area several inches in each direction. The nodes of the net are black, the spider-web connecting threads, transparent, glassy.

V. TRICHIACEÆ.

Sporangia single, seldom united to form an æthalium. Peridial thickenings, calcareous granules (usually) and columella none. Capillitium of tubular threads, simple, branching or united in a net; free or united with the peridium or the stipe. Spores and capillitium usually yellow or red, more rarely whitish or brown, not violet.

KEY TO SUB-FAMILIES.

A. Capillitium plain, ... PERICHÆNEÆ.
B. Capillitium-threads with the walls variously thickened, . ARCYRIEÆ.
C. Capillitium-threads furnished with spiral bands, ... TRICHIEÆ.

A. Perichæneæ.

This sub-family contains but a single genus, viz:

PERICHÆNA, *Fries.*

Sporangia sessile, generally opening with a lid. Peridium simple or double; when double the outer fragile with lime granules, the inner thin membranous. Capillitium with thin smooth walls, the filaments springing from the upper wall and either branched or simple. Spores yellow.

9. PERICHÆNA CORTICALIS, *Batsch.* Plate II, Figs. 1, 1*a* and 1*b*.

Sporangia sessile, gregarious, flattened, hemispherical. Peridia simple, opening by a lid (dehiscence circumscissile), the upper part chestnut brown, the lower almost black. The capillitium feebly developed, smooth, attached to the lid and usually coming away with it, bringing the brilliantly yellow spore mass, and leaving a delicate shining cupule adherent to the substratum. Spores yellow, smooth, .010–.012. On and under the bark of dead elms of various species.

A very handsome litttle species occuring rarely with us, or

perhaps over-looked by virtue of its protective coloration. Found sometimes on the inner side of the bark where the latter has separated but not yet wholly parted company with the wood. In such situations the tiny sporangia are so nearly quite the color of the moist substratum as to escape all but the closest scrutiny. The dehiscence is very remarkable, characteristic, beautiful. Black, brown, chestnut and gold are harmoniously blended, in the opening coffers. Prior to maturity the future line of fission is plainly indicated by the difference in color.

B. Arcyrieæ.

OLIGONEMA, *Rostafinski.*

Sporangia sessile crowded. Peridia simple, opening irregulary. Capillitium tubes free, simple or little branched, plain or adorned with a few scattering rings. Spores yellow.

10. OLIGONEMA NITENS, *Libert.* Plate II, Figs. 8, 8*a* and 8*b*.

Sporangia very small, sessile or gathered in heaps. Peridial walls gilvous, glistening, breaking irregularly at maturity. Capillitium tubes (elaters) free, irregular, sometimes short and simple, sometimes branching, blunt at each end, the walls furnished here and there with annular thickenings. Spores yellow, spherical, covered with reticulate thickenings, in diameter about .012. On moss, sometimes escaped to twigs and leaves.

The brilliant yellow of this species leaves it without a rival here. In fact as to color its only rivals are other species of the genus, *Oligonema flavidum*, Pk., for example which differs from *O. nitens* in the more strongly developed capillitium, the tubes of which carry no annular rings, but show their Trichia relationship by faint spiral threads rather closely wound. In *O. nitens* the spores are more varied both in sculpture and size. Plasmodia small, hardly a centimeter, at most, in our material.

CORNUVIA, *Rostafinski.*

Fruiting phase assuming the form either of distinct sporangia or plasmodiocarpous. Peridia opening irregularly or sometimes with a lid. Capillitium, a free net, adorned with papillæ, spinules, or ring-like thickenings.

11. CORNUVIA WRIGHTII, *Berkeley* and *Cooke.* Plate II, Figs. 7, 7*a* and 7*b*.

Fruiting phase various, sometimes single, spherical, nut-brown sporangia opening irregularly, more frequently in O-shaped or U-shaped plasmodiocarps, or vein-like, creeping. Spores and capillitium bright yellow. Threads of the capillitium .002–.003 wide, adorned with scattered spinules about equalling in length the thread's diameter. Spores delicately warted, about .012.

The fruit of this species is like that of *Perichæna corticalis* in general appearance, as in color of spore-mass, and in habitat; is however easily distinguished by its irregular forms, as by its capillitium and other microscopic characters. Found not uncommon in September and October on half-rotten logs and bark, particularly of elm-trees. The species appears to run into *C. circumscissa* Vall. by way of *C. circumscissa* var. *spinosa*, Schrœter.

ARCYRIA, *Hill.*

Sporangia simple, at first spherical or ovate, stalked, generally resting upon a common hypothallus. Peridium opening by a quasi-circumscissile dehiscence, the upper part vanishing, the lower remaining as a cup. The capillitium united to form an intricate closed net, which at the rupture of the peridium, suddenly springs aloft, widens and lengthens, free above but still adherent to the peridial walls below. Spore-mass and capillitium white, yellow or red. (Schrœter).

SUB-GENERA.

I. Capillitium adherent to the margin of the persistent cup-like base of the peridium, ... CLATHROIDES.
II. Capillitium closed below and adherent to the peridium but slightly and at but a single point, ... ARCYRELLA.

Sub-genus Clathroides, (Micheli) Rostafinski.

12. ARCYRIA CINEREA, (*Bulliard*). Plate II, Figs. 3 and 3*a*.

Peridia gregarious, stalked, elongate ovate; stipe simple, straight, smooth, fuscous. Capillitium and spore-mass pale ashy grey; tubes of the capillitium warty or spinulose. Spores smooth, .006–.008, colorless. Plasmodium bluish-white in very delicate reticulations.

This species although world-wide in distribution occurs sparingly with us—has in fact been collected but once, on decaying stumps of *Tilia americana*, "bass-wood." The sporangia after the expansion of the capillitium are long persistent, the capillitium itself assuming a definite and characteristic outline, with beautiful tracery-like reticulations. The spores extend down into the stipal cavity. July, 1886.

13. ARCYRIA PUNICEA, *Persoon*. Plate II, Figs. 5 and 5*a*.

Peridia crowded, commonly stalked, more or less ovoid, lustrous. Stipe straight, of varying length, spirally plicate. Color of all parts various in different cases, generally flushed with a roseate or carmine tinge, sometimes brilliant. Capillitium thread equal, flattened, adorned with thickenings in form of rings or half-rings. Spores smooth, .006–.007. July—December.

This is one of the commonest species of the whole list. World-wide in distribution it seems to occur in any given locality with a constancy and persistence that bespeaks thorough adaptation to environment and present terrestrial conditions generally. I find it uniformly upon fallen stems of *Populus* and *Tilia*, possibly because in our dry season these

woods better than some others retain the moisture. It is readily distinguished from other species of the sub-genus; from the preceding by its color; from *A. pomiformis*, Roth., by its habit (crowded) and the character of the capillitium,—spinulose in *A. pomiformis*. The delicate half-rings in *A. punicea* form a more or less spiral series around the capillitial thread.

Sub-genus Arcyrella, Rostafinski.

14. ARCYRIA ADNATA, *Batsch.*

Sporangia, crowded or gregarious on a distinct hypothallus, ellipsoidal; stipe short but distinct. Spores and capillitium ochraceous with a carmine flush; tubes of capillitium equal, adorned with abundant half-rings, cross-plates, or often sharp edged plates, which appear in section like spines, very variable. Spores concolorous with capillitium, smooth, .007–.008.

This species resembles the preceding in nearly every particular and is distinguishable only by observing the attachment of the capillitium. Both tubes and spores may often be traced far down into the stem. The peridia are as a rule larger in the present species and likewise the spores. *A. adnata* is with us much brighter colored, often a brilliant carmine brown, vying with *Hemiarcyria rubiformis*. Habitat the same as the preceding species; plasmodia white. September—December.

15. ARCYRIA VITELLINA, *Phillips.* Plate II, Figs. 4 and 4*a*.

Sporangia crowded, large, short stipitate, ovoid or cylindric, luteous, opening by an irregular circular fissure. Capillitium shining luteous, elongate-clavate, nodulose; threads with minute tubercles and distant rings. Spores concolorous, .010 in diameter.

The specimens referred to this species occur rarely with us. The sporangia are crowded on a distinct hyphothallus,

very short-stalked, leather-yellow or ochraceous in color. Capillitium nodulose at the intersections of the threads which are rough with minute papillæ or short spines but no rings. The peridial cup shows a margin with petaloid lobes. Too near the ochraceous forms of the preceding species.

16. ARCYRIA NUTANS, *Bulliard.* Plate II, Figs. 6, *6a* and *6b.*

Sporangia crowded, elongate, short stipitate or sessile by an acute base. Spores and capillitium-mass, pale straw-colored, or yellow. Capillitium lax, very long flexuous, erect-nodding, at length decumbent; capillitium threads adorned with distinct irregular spinules.

This elegant species is not rare in undisturbed woods especially on fallen willows. The expanded capillitia are very soft and plume-like, waving and nodding, very lightly attached below to the center of the peridial cup. The capillitium threads are rough with irregular spines and sharp-edged transverse plates, occasionally extending to form rings. Resembles the next except in color. Spores smooth, .0084–.009. Autumn.

17. ARCYRIA ŒRSTEDTII, *Rostafinski.*

Sporangia ovoid, in typical forms stipitate with short stipe; capillitium and spores nut-brown or fuscous; capillitium threads cylindric with not infrequent vesiculose expansions, abundantly and uniformly spinulose. Spores smooth, .008–.009.

A very handsome species; in size and external appearance, save color, much resembling *A. nutans.* The capillitium threads are however decidedly different, being uniformly spinulose with rather long aculeate spinules. The vesiculose thickenings occur rarely. Found on prostrate trunks, logs, in marshy places. July—September. Decorah. Mr. Holway.

LACHNOBOLUS, *Fries.*

Sporangia sessile, (or very short-stalked), gregarious or closely packed together. Peridium wall exceedingly delicate, smooth, opening irregularly. Capillitium forming a loose net attached by numerous branches on all sides to the peridial wall. Spore-mass with capillitium delicate rose or flesh-colored, or yellow.

18. LACHNOBOLUS INCARNATUS, *Albertini* and *Schweinitz.* Plate II, Figs. 2, 2*a* and 2*b*.

Sporangia spherical or ellipsoidal, about .005 broad, rarely distinct, usually closely agregated. Peridium membranous, fragile, flesh-colored, shining. Capillitium of manifold branching threads united to form a loose net, the threads characterized by numerous expansions or nodes .010–.018 broad, and everywhere finely punctate. Spore-mass bright flesh-tinted; spores .0075–.009, smooth.

The specimens referred to this species are so placed from description only, the author having no authenticated specimens for comparison. Of the correctness of the determination there seems, however, no reasonable doubt. The capillitium is absolutely characteristic. The only points in which our material departs from the description given by Schrœter, are the somewhat greater (average) diameter of the spores and capillitium nodes.

LYCOGALA, *Micheli.*

Æthalia rounded, more or less nearly spherical, single, gregarious, or crowded, coalescent. Peridial wall double, the outer membrane, thick, papery, not smooth; the inner more delicate, affording support to the richly developed, very irregularly expanded, branching and reticulated capillitium.

19. LYCOGALA EPIDENDRUM, *Buxbaum*. Plate III, Figs. 1, 1*a* and 1*b*.

Æthalia gregarious, sometimes closely packed together, a centimeter more or less in diameter, opening irregularly at the apex. The outer peridial wall ashen or fuscous, usually with a flush, minutely roughened. Spores and capillitium varicolored, rosy, purplish, ashen, clay-colored, etc., at length fading. Spores .003–.006, smooth.

This species and the next are the "puff-balls" of the group. The general resemblance to the smaller forms of the gaster-omycetes is remarkably close. The outer covering, the abundant dusty spores, the persistent floccose capillitium, all combine to deceive the inexperienced collector. Nevertheless there are no hyphæ here. The plasmodium of the species named spends the period of vegetation among and between the cells of decaying wood of various sorts, at length to emerge in rouge-colored or scarlet masses as large as peas or larger, which are gradually transformed into dessicated sacs of powdery spores. The peridia when old are exceedingly brittle, and break in every direction, but normally discharge the spores through a cleft apex. The capillitium is very curious, made up of irregulary branching and anastomosing plates, with numerous free ends and slender twig-like append-ages, all roughened by scattered papillæ. The spores are among the smallest, in mass often brightly tinted epecially when fresh, smooth and colorless under the lens, are often not dispersed for months after development. *L. epidendrum* is world-wide in distribution, exceedingly common at all seasons, although developing fruit only in the summer,—July to September. Found most commonly on apple and linden stumps and fallen stems.

20. LYCOGALA FLAVO-FUSCUM, *Ehrenberg*. Plate III, Fig. 2.

Æthalia resting for the most part upon a well developed hypothallus, large, spherical or piriform, sometimes pendent.

Peridium thick, ashy or amber, generally with a roseate flush, smooth or irregularly obscurely reticulate. Spore-mass bluish-gray; capillitium concolorous. Spores, .0054–.006.

Not common. Found on all sorts of stems and stumps in woods. Generally solitary, easily distinguished from the preceding by its size, shape and color. Specimens sometimes attain the size of a walnut (2 centimeters in diameter), more commonly of a hazel-nut.

C. Tricheæ.

TRICHIA, *Haller.*

Sporangia distinct, sessile or stipitate. Tubes of the capillitium free, simple or rarely branching, with acuminate ends, the walls adorned with spiral threads or bands.

21. TRICHIA FALLAX, *Persoon.* Plate IV, Fig 2, *2a* and *2b*.

Sporangia single, gregarious, top-shaped or piriform, stalked; peridium olive-brown, opening irregularly, shining. Stipe hollow, filled with spore-like cells. Capillitium and spore-mass dull yellow, the elaters often branched, with long acuminate ends, and adorned with three or four smooth thin spiral bands. Spores yellow, minutely verruculose, .010–.012.

A very beautiful, well defined species; easily recognized at sight by its distinct pear-shaped, stalked and shining sporangia. Under the lenses the elaters with their long tapering pointed ends are sufficiently definitive. The stipe is fuscous, almost or quite black. The plasmodium is described as flesh-colored, the young peridia, scarlet. The spores are described as *minutely rough* by all the authorities. Under lenses of low magnifying power this is apparently true; but under a fine lens, Leitz's one-sixteenth oil-immersion, for instance, the spore shows a delicate reticulation over its whole surface. This is not the effect of optical illusion, as might perhaps be surmised, following analagous experience in the microscopical examinations of Diatoms, for example. The net-work is

exceedingly delicate, but withal sharply defined. Once seen it may be afterwards easily discovered under lenses much lower in magnifying power, as Leitz No. 7. The figure, Plate IV, Fig. 2*a*, shows the episporic character as we believe it really to be. *Trichia scabra* shows the same peculiarities in the surface of its spores. It may be thought that the trouble lies in our incorrect identification, and that we have here to do with other species than those described by European authors. But *T. fallax* is a species perfectly defined by other characters, recognizable at sight by characters macroscopic. We are rather inclined, as already hinted, to ascribe the discrepancy to differences in lenses. Under a somewhat old-fashioned water-immersion, one-twelfth, the reticulations would escape notice entirely, the spores of *T. scabra* for instance appear as Rostafinski has portrayed them. We submit the case to the arbitration of good lenses. Not rare; chiefly found on fallen sticks of soft wood. September—November.

22. TRICHIA VARIA, *Persoon*. Plate IV, Figs. 3, 3*a* and 3*b*.

Sporangia generally sessile, gregarious or compactly placed, of various shapes, pale yellow or straw-colored. Spore-mass and capillitium rather bright-yellow though sometimes rusty or brown. Elaters thin-walled, adorned with two rather distinct spiral bands, the ends acute. Spores, delicately warted, .010–.012.

Perhaps our most common species, to be recognized by its usually pale color, and in the common form, depressed, polygonal irregular sporangia. Three varieties are recognized:—

a. genuina, as just described.
b. sessilis. Sporangia top-shaped, with a discoidal scarce perceptible stipe.
n. nigripes. Sporangia piriform or turbinate with a short fuscous or black stem.

Found on all sorts of decaying wood and bark and even manure, from July till September. The elater bands wind in

a direction the reverse of that usual in other species; hence the specific name *varia*. The spores here are verruculose; show no reticulations however highly magnified.

23. TRICHIA CHRYSOSPERMA, *Bulliard*. Plate IV, Figs. 5, 5*a* and 5*b*.

Sporangia sessile, crowded, spherical, or, by mutual interference, polygonal, dull ochraceous, or olivaceous yellow, all on a well developed hypothallus. Spore-mass and capillitium brilliant golden-yellow. Elaters long, simple, with tips, acuminate, and with 3–5 spiral bands joined by more or less conspicuous secondary thickenings running parallel to the long axis of the tube. Spores covered with a banded net-work forming polygonal meshes, yellow in color, .012–.015.

This species stands as the type of a series all characterized by spores with plain band-like thickenings of the epispore. Mr. Massee in the *Revision of the Trichiaceæ* creates a number of species based upon variations in the pattern formed by these thickenings. As every gradation occurs from that in which the thickening takes the form of simple patches on the spore-wall to the case in which the elevations form polygonal reticulations, enclosing the spore as in a net, it will be apparent that the number of possible species is great. *T. affinis*, De Bary, following, is the type of another similar series in all of which the episporic bands are "pitted." Mr. Massee's service in establishing the fact of such series, deserves all praise; but that the erection of new species on characters so variable is fortunate, seems more than doubtful. The longitudinal markings of the elater, for instance, are by no means characteristic of *T. chrysosperma*, as may be seen by comparison of the figures on Plate IV. The present author suggests the recognition of but two species distinguished as De Bary drew the lines. Under these two all other forms claiming specific rank may be ranged and recognized, to such extent as men please, as varieties. The fact is that the systematist

will have difficulty enough to keep these two species apart, as more and more with the progress of our knowledge intergrading forms come into sight. Chrysospermatous specimens, so far as discovered or examined here, all exhibit spore-reticulations reasonably complete; *i. e.*, we have here the typical *T. chrysosperma*.

A comparatively common and most beautiful species. No yellow more golden; no elaters, more graceful; no spores, more finely sculptured. Zopf reports the plasmodium white. Specimens occur in July and August on substrata of various sorts,—logs, bark, patches of moss, etc.

24. TRICHIA AFFINIS, *De Bary*. Plate IV. Figs. *6c* and *6d*.

Sporangia sessile on a more or less distinct hypothallus, spherical or ovoid, crowded together. Spore-mass and capillitium yellow. Elaters with several spiral bands, rough, with short spinules, the tips more or less swollen, terminating in an acute point. Spores adorned with reticulate bands which are pitted along the median line, .010–.012.

Under this species we may recognize the varieties following:

a. *T. jackii*, Rost. Differs from the type only in that the spore reticulations are less perfect, an occasional free end appearing.

b. *T. abrupta*, Cke. Tips of the elaters bifurcated; *i. e.*, exhibiting generally two or more large spinules at right angles to the axis of the elater; spirals not joined by vertical bars; reticulation less perfect but of the pitted order. Figs. 6, *6a* and *6b*.

c. *T. intermedia*, Mass. Has spores similar to those of *T. abrupta*, but has the spiral bands connected by longitudinal ridges, and the elater tips are simple, not forked. Figs. 1, *1a*, *1b* and *1c*.

The phase common here is the *T. affinis*, var. *intermedia*, for the spirals are connected; variety *abrupta* also occurs, and our

forms of *T. affinis* would perhaps be deemed *Trichia jackii* by some authors, as the spores do not nearly all show complete reticulations. *T. proximella*, Karsten, N. A. Fungi, No. 2690 undoubtedly belongs to this series. At least in our specimen the spores resemble those of varieties *b* and *c* above.

All phases here are common in the fall, from September to December, on decaying logs of every sort.

25. TRICHIA SCABRA, *Rostafinski.* Plate IV. Figs. 4, 4*a* and 4*b*.

Sporangia sessile, crowded, on a well developed hypothallus, bright yellow. Elaters cylindrical, acute at the apex, straight or scarcely curved; spiral bands, three or four covered with numerous short acute spinules, the intervals quite wide and smooth. Spores minutely warted, .008–.011.

Species not rare, occurring on fallen limbs, stumps, etc., handsome. Easily recognized by the above characters, especially those pertaining to the elaters. The color is sometimes rusty. The papillæ which cover the spore show, when highly magnified, a distinct net-like pattern, as described under *T. fallax;* not at all rough, as hitherto described and sometimes figured. September.

26. TRICHIA, INCONSPICUA, *Rostafinski.* Plate III, Figs. 5, 5*a* and 5*b*.

Sporangia small, more or less spherical, collected in heaps or scattered (discrete), brown, shining, inconspicuous, destitute of hypothallus. Elaters cylindrical, extended at tip into spines curved to one side and twice as long as the elater-width, sometimes also inflated near the tip. Spiral bands three or four, not conspicuous, with narrow intervals. Spores delicately warted, .012–.013.

Specimens have been referred to this species without comparison. The form is rare, but corresponds in all essential par-

ticulars to the description as above. The sporangia are as often reniform as spherical; the elaters often bifid at tip as in Fig. 5*a* referred to above. October.

27. TRICHIA IOWENSIS, *Macbride*, n. s. Plate V, Figs. 4, 4*a* and 4*b*; and Plate X, Fig. 5.

Sporangia sessile, gregarious, spherical or reniform, with no hypothallus, purple-brown. Spores and spore-mass, yellow. Elaters with three or four spiral bands unevenly distributed, and with occasional inflations, sparingly branched, spinulose especially where inflated; spinules long, .003–.006, and recurved, often bifid or trifid, especially at or near the acuminate tip. Spores delicately warted, .009–.011.

This species occurs rarely; is found on the bark of *Populus*, so far, exclusively. The sporangia are inconspicuous until opening by fissure they display the yellow spores and capillitial threads. The species is immediately recognized by its elaters whose numerous and lengthened spinules are unlike those of any cognate form, reminding one of the capillitium of *Cornuvia*. Woods, near Iowa City; October.

HEMIARCYRIA, *Rostafinski*.

Capillitium united into a net, either free, or by its lower branches bound back to the stem or to the basal part of the peridium. Peridium opening irregularly. Threads of the capillitium spirally banded.

28. HEMIARCYRIA RUBIFORMIS, *Persoon*. Plate V, Figs. 1, 1*a* and 1*b*.

Plasmodial and fruiting phases alike ruby-red. Sporangia stalked, turbinate or piriform; stems commonly coalescent so that the sporangia are clustered. Peridium at first shining with metallic lustre, at length duller. Spore-mass and capillitium reddish-brown; capillitium net with many free, pointed

tips, spinescent throughout. Spiral bands distinct, about three. Spores smooth, .010–.012.

Our most common Slime-mould, found on rotten wood and bark of all sorts from June to September, easily recognized by the color. Several varieties are recognized, of which *genuina*, stalked, as described, alone occurs here. All authorities agree in describing European specimens with "spores smooth." I have not had opportunity to examine with the microscope European material, but a most careful observer who has so done reports that the spores of specimens sent him from Europe are *not* smooth. The material distributed in the N. A. F. No. 1113, agrees with our Iowa material in having the spores minutely verruculose. On the fact of rough spores, Massee founds the species *H. ellisii.* (Jour. Roy. Mic. Soc., 1889, p. 354). If then Massee's point were well taken, our species must be called hereafter *H. ellisii*, Mass.

29. HEMIARCYRIA CLAVATA, *Persoon.* Plate V, Figs. 2, *2a* and *2b*, and Plate III, Figs. 6, *6a* and *6b*.

Sporangia single, gregarious, spherical or obclavate. Peridium thin, bright, shining, yellow. Stipe generally of a darker hue, brown or reddish. Spore-mass and capillitium yellow or ochraceous. Capillitium repeatedly branching, with abundant free, rounded ends, the tubes adorned with several spiral bands. Spores minutely warted, .008–.009.

Very common, occurring with the preceding, the plasmodia of the two species being often strangely intermingled on the same substratum. Under a good lens (Leitz $\frac{1}{16}$) the capillitial threads show themselves minutely warted. The specimen distributed by N. A. F., 536, shows the same peculiarity. Authorities generally ignore the fact, or say "smooth."

The figures of Plate III, illustrate a very delicate variation of the present species. The sporangia are much smaller, borne on proportionately longer stipes. The capillitium is less

frequently branched, shows no free ends; has in fact the general appearance of an *Arcyria* except that the tubes are spirally banded, and are generally smooth.

30. HEMIARCYRIA SERPULA, *Scopoli.* Plate V, Figs. 3, 3*a* and 3*b*.

Plasmodiocarp depressed, sessile, creeping, commonly united into a loose net, bright-yellow, as also the spore-mass and capillitium, branched, tubes about half as wide as the diameter of the spores, the spiral bands armed with abundant rather stout spinules. Spores covered with net-work, .012–.013.

Rather common in September and October on rotten logs, stumps, etc., in the woods. The vein-like elements of the plasmodiocarp usually unite in every direction to form an elegant net a centimeter or two in diameter, but may instead wind aimlessly about, forming naught but loops or hooks, or wavy lines. A very pretty and curious organism, figured by Corda (*Icones*, Plate II, Fig. 34) under the winding title of *Hyporrhamma reticulatum*, and described by Fries as *Trichia serpula*. On maturity the peridial membrane breaks irregularly along the medial line revealing the golden yellow spores and capillitium, the latter remarkably hygroscopic, constantly in motion. The spores are beautifully netted, reminding one of the spores of *Oligonema*.

31. HEMIARCYRIA STIPATA, *Schweinitz.* Plate I, Figs. 8, 8*a* and 8*b*.

Sporangia distinct, though often crowded, stalked, cylindric, rich brown or copper-colored, shining, borne on a more or less distinct hypothallus. Peridium thin, the upper portion at maturity irregularly evanescent, the base persistent as a shallow cup. Spore-mass and capillitium reddish; capillitium united in a loose net with many free and bulbous ends, the tubes pale, granular within, marked without by obscure spiral bands

and occasional wart-like or plate-like thickenings (Arcyrioid). Spores smooth, about .006. Decorah. Mr. Holway.

A beautiful species, recognizable at once by its large size and bright color, a deep brown carmine-tinged. *Arcyria adnata* shows sometimes similar tints, but the sporangia are more crowded and much smaller. The capillitium is puzzling. With numerous free ends it yet exhibits only faint spiral bands; distinct enough under a Leitz No. 7, much better under a one-sixteenth immersion. It is one of those boundary forms which appear to belong about equally on either side of our lines of generic demarcation. The spiral threads are however a good character, fortunately in the present instance rëinforced by the indubitably free bulb-like tips. Not to be confused with Mr. Massee's *H. stipitata*, which is similar in the specific name only.

VI. RETICULARIACEÆ.

Fruiting phase an æthalium, covered by a distinct papery membrane. Spore-mass and capillitium brown or violet-black.

Spores and capillitium brown, ... RETICULARIA.
Spores and capillitium violet-black—not represented in our locality, ... AMAUROCHÆTE.

RETICULARIA, *Bulliard.*

Fructification at maturity forming a large cushion-like æthalium. Spore-mass and capillitium umber-brown.

32. RETICULARIA LYCOPERDON, *Bulliard.* Plate III, Fig. 3, and Plate X, Figs. 7 and 7*a*.

Plasmodium white or yellow, branching, at length forming a white slimy mass. Mature æthalia, three to six centimeters in diameter, covered with a shining, silvery, paper-like, peridial membrane, and seated on a well developed hypothallus.

Capillitium flat, branching again and again. Spores clustered, reticulate except on the contact portion, about .009.

The only species of the genus; not common here, although reported so in other parts of the country and the world. To be distinguished from *Enteridium rozeanum* by the capillitium, less easily by external characters. The spores seem to me very similar. In *Enteridium* the spores have been described as warted. In both cases they are certainly delitely and beautifully reticulate.

On rotten wood of various sorts. September. The specimen figured (natural size) is unusually large.

VII. STEMONITACEÆ.

Sporangia at maturity distinct. Peridium delicate, without lime and generally completely deciduous. Capillitium of solid threads which spring branching from a columella or (rarely) from the tip of the intruding stipe. No lime. Spore-mass and capillitium violet-black.

KEY TO GENERA.

Peridium somewhat persistent, ... LAMPRODERMA.

Peridium fugitive disappearing wholly before the maturing of the spores—

1. Sporangia gregarious, tips of capillitium not united to form a net, ... COMATRICHA.
2. Sporangia crowded, ultimate branches of capillitium united, ... STEMONITIS.

LAMPRODERMA, *Rostafinski*.

Sporangia spherical or ellipsoidal, stipitate. Peridium membranous, persistent, generally with a metallic lustre. Stipe lengthened to form the columella which is hardly half as high as the sporangium, and is cylindrical or clavate in form. Capillitium springing from the columella, the threads dichot-

omously branched and becoming thinner outwardly, occasionally anastomosing.

33. LAMPRODERMA ARCYRIOIDES, *Sommerfelt*. Plate III, Figs. 4, *4a*, *4b* and *4c*.

Sporangia spherical, stalked. Peridium, thin, violet or bluish, with a metallic lustre. Stipe very short, or reaching a millimeter in height, brown, shining, borne on a distinct hypothallus. Columella cylindric, truncate in the globose forms. Capillitial threads white or whitish, repeatedly branched and more or less anastomosing. Spores dull violet, more or less spinescent, .012–.016.

This species occurs rarely, usually on the bark of fallen logs in undisturbed woodlands. Both short and long-stalked forms have been collected. The plasmodium is at first almost transparent, then amber-tinted, sending up tiny semi-transparent spheres on rather stout brownish stalks. The sporangia become deeper brown and at length gradually assume the structure and exquisite color of maturity. The rich metallic lustre is very attractive. Metallic steel-blue or "peacock blue" describes perhaps the reflected colors, which, among all the species here described find rival in *Diachæa splendens* only. The spores are quite smooth in our specimens, but very variable in size. August—September.

COMATRICHA, *Preuss*.

Sporangia cylindrical or globose, not crowded, stipitate, the stipe entering the sporangium and prolonged as a columella nearly to the top. Capillitium made up of branches which arising from the columella repeatedly branch and unite but not so as to form a distinct net at the surface. Peridium a thin evanescent membrane or wholly lacking.

34. COMATRICHA TYPHINA, *Rostafinski*. Plate VI, Figs. 1, *1a* and *1b*.

Sporangia gregarious, distinct and isolated, cylindrical,

obtuse. Stipe shorter than the sporangium, black. Columella rising to the middle or farther, then spreading into many divergent branches; capillitium threads many times branched, anastomosing to form an intricate net. Spores bright violet, smooth, .004–.005.

The common species everywhere, variable in size and in the structure of the capillitium. The anastomosing twigs of the capillitium form a net of varying intricacy for containing the spores, but the ultimate tips are free. In the arrangement of species in this genus, I follow Dr. Rex, who makes the peculiar surface markings of the spores diagnostic. These in the present species, are not absolutely smooth, but under a good lens show, as in Fig. 1*a*, Plate VI, minute papillæ with a few larger warts distributed here and there. In the species following the spores are larger and more distinctly and uniformly warted. The peridium is rarely seen.

35. COMATRICHA PULCHELLA, *Bab.* Plate VI, Figs. 3, 3*a*, 3*b*, 3*c* and 3*d*.

Sporangia elongate-ovate or cylindrical, obtuse at apex. Stipe slender, subulate, black, extending as a branching columella almost to the apex of the sporangium, the branches uniting to form a very intricate net. Spores pale, delicately verruculose, .0075–.008.

Not common; occurring in the same situations as the preceding, easily distinguished by its larger, roughened spores. In form the sporangia vary greatly; sometimes short, cylindric almost sessile, then as in Fig. 3, long, stipitate, and slender. The peridium is well developed and forms an evanescent but distinct membrane, Figs. 3*c* and 3*d*.

36. COMATRICHA CRYPTA, *Schweinitz.*

Sporangia cylindrical, obtuse, dull opaque, closely gregarious. Stipe short, rather stout, extending as columella almost,

if not quite, to the apex of the sporangium. Capillitium very loose, the branches only two or three times dichotomous. Spores brown, rough, with irregularly scattered papillæ, about .009. October—November.

This species differs even to the naked eye from both the preceding. The sporangia are more closely placed and have a singularly ragged chenille-like appearance and are blue-black in color. The spores are very large for this genus and distinctly papillose under moderate magnification. The capillitium is also much more lax, its ultimate divisions much as in the next. Identified by comparison with specimens furnished by Prof. A. P. Morgan.

37. COMATRICHA LONGA, *Peck.* Plate VI, Figs. 2, *2a* and *2b.*

Sporangia cylindrical, long and slender, on a distinct hypothallus, crowded, dull black in mass. Stipe delicate, black and shining, one-sixth to one-fourth the entire length of the fruit, extending as columella to the obtuse apex of the sporangium. Capillitial threads branching very lax and open, the branches comparatively short, rigid. Spores rough, warted, .009. September.

A very remarkable and well marked species. The sporangia stand nearly a centimeter high, occur in more or less tangled mass and at first suggest a weathered *Stemonitis.* The open net-work is an exaggeration of the type exhibited in the species last named. Colonies are an inch or less in diameter on bark of fallen trees. Rare. Identified by comparison with material sent by Dr. Geo. Rex.

STEMONITIS, *Gleditsch.*

Plasmodium at first white, at length heaped in rounded cake-shaped mass which at maturity becomes slowly modified into the crowded but distinct stiptitate sporangia. Stipe continued within the sporangium as in *Comatricha* to form the columella

which gives off on all sides the branching capillitium, the ultimate divisions uniting to form a superficial net, parallel to the wall of the vanishing peridium.

The genus is closely related to the preceding from which it may be distinguished by the crowded sporangia of usually greater size, the less evident dichotomy in the branches of the capillitium and the indubitable net by which all is surrounded. In the specific determinations I have followed Dr. Rex in the N. A. F.

38. STEMONITIS FUSCA, *Roth.*

Sporangia cylindrical, tufted, nodding, borne on a well developed hypothallus. Stipe rather short, extending as columella quite to the apex of the sporangium. Capillitium and spore-mass brown-violet. Capillitium-net with fine meshes, about equal to the diameter of the spores. Spores pale, almost smooth, .005–.0075. September—October. N. A. F. No. 1119.

Rather rare here as elsewhere in this country, the next species being the common form. Hardly distinguishable except by the smoother spores from *D. dictyospora*, Rost., and *S. maxima*, Schw., N. A. F., No. 2697.

39. STEMONITIS MAXIMA, *Schweinitz.* Plate VI, Figs. 4, 4*a* and 4*b*.

Sporangia cylindrical, long, slender, obtuse; the stipe black, borne on a glistening hypothallus. Columella and capillitium as in the preceding. Spores verruculose, the papillæ forming a reticulate pattern, .006–.007.

Both this and the preceding present after maturity the most dainty, airy, plume-like, ashen tufts of softness and beauty indescribable. The chief distinction lies in the surface characters of the spores. Concerning *S. dictyospora*, Rost., Dr. Rex, *in litt.*, says: "*S. dictyospora*, Rost. differs from *S.*

maxima, Schw., only in the fact that in the former the bases of the warts forming the polygons on the epispores are joined together into reticulations, while in *S. maxima* they are not. If it be said that such difference is not sufficient for specific separation, so much the worse for Rostafinski's species; Schweinitz's being the older has precedence." The spores in our specimens are evidently netted. The clustered sporangia are found on stumps, logs, or even on the ground; the winds of September soon scatter the spores but the delicate tufts persist long, and in sheltered situations may be found at almost any season. N. A. F., No. 2697.

40. STEMONITIS MORGANI, *Peck*. Plate VI, Figs. 6, *6a*, *6b* and *6c*.

Sporangia long, cylindrical, crowded, arising from a well developed hypothallus, stalked, the stalks short, black, shining, extended to form a columella which scarcely reaches the apex of the peridium. Capillitium net with meshes wide and bearing subtriangular thickenings at the intersections. Spores violet-brown, globose, adhesive, .008, minutely warted.

This elegant species occurs not rarely on rotten wood, usually in protected situations, although sometimes on the exposed surfaces of its habitat. The sporangia attain with us unusual height, sometimes two centimeters. Plasmodia three to eight centimeters in diameter. The clear brown tufts appear in fall, marvels of graceful elegance and beauty.

Figs. 7 and *7a*, on Plate VI, is a variety with shorter and broader sporangia, the net-meshes coarser; otherwise perhaps not distinct. Fig. *6a*, should not have appeared on the Plate. It is Fig. *6c*, less highly magnified.

41. STEMONITIS FERRUGINEA, *Ehrenberg*. Plate VI, Figs. 5, *5a*, and *5b*.

Sporangia gregarious or cœspitose, rising from a distinct shining hypothallus, cylindrical, obtuse; columella reaching

the apex of the sporangium, Stipe setaceous, black, shining, comparatively long; spore-mass cinnamon-brown. Spores smooth, pale, .0045–.006. September—November. N. A. F., No. 1118.

Not uncommon on rotten wood; August. The color is distinctive at sight. The spores are smooth, very variable in size. Fries reports the plasmodium yellow, and De Bary, Mycetozoa, gives detailed account of the development of the sporangia.

VIII. SPUMARIACEÆ.

Sporangia single and distinct, or blended to form æthalia. Deposits of lime in the peridium or stipe, never in the capillitium. Columella cylindric, well developed. Capillitium radially developed from the sides and ends of the columella and extending to the peridium, its threads branching and uniting.

KEY TO THE GENERA.

Sporangia single, distinct, ... DIACHÆA.
Sporangia united in æthalia, ... SPUMARIA.

DIACHÆA, *Fries.*

Sporangia simple, stipitate, stipe produced to form a columella which almost traverses the sporangium. Peridium very thin, evanescent. Stipe and columella with fine calcareous granules. Capillitium rising from the columella, repeatedly branched. Spore-mass violet-black.

42. DIACHÆA SPLENDENS, *Peck.* Plate VII, Figs. 1, 1*a*, 1*b* and 1*c*.

Peridia metallic-blue or violet, delicately globose, sub-persistent, irregular in dehiscence. Capillitium threads delicate, tinted. Stipe white, scarcely entering the sporangium. Spores clustered, black, globose, verruculose, .007–.010.

This is perhaps the most showy species of the list. The brilliantly iridescent sporangia are lifted above the substratum on snow-white columnar stalks; these are again joined one to another by the pure white vein-like cords of the reticulate hypothallus. The plasmodium may spread very widely over all sorts of objects that come in the way, dry forest leaves and sticks, or the fruit and foliage of living plants. I am indebted for specimens to Mr. Holway, of Decorah, who reports that the plasmodium seemed to over-run "a whole hillside." The very closely related and likewise exceedingly beautiful species, *D. lencopoda*, Bulliard, is to be looked for here as it has been found east of the Mississippi river. It differs from the present form only in having cylindric instead of globose sporangia. The stipe in our specimens is much broader than the cylindrical columella. July—August.

SPUMARIA, *Persoon.*

Sporangia united to form æthalia, more or less branching, covered with a foam-like calcareous cortex. Columella likewise branching, the capillitium passing from the columella to the sporangium walls and forming an intricate net.

A single species only, and that limited to Europe and North America.

42. SPUMARIA ALBA, *Bulliard.* Plate VII, Figs. 6, *6a* and *6b.*

Plasmodium white; fruit-masses ashen or gray, one to two centimeters wide, two or three long, very fragile and porous. Columella hollow, not attaining the end of the sporangium. Capillitium-net more or less thickened at the points of intersection. Spores violet-black, very rough, .012–.014.

Not rare in July and August on various parts of living plants. The white frothy plasmodium creeps from its nutritive base up blades of grass or stems of herbaceous plants, sometimes for the distance of a foot or more, and is scarce

distinguishable from any frothy substance of accidental occurrence. Presently the whole mass undergoes internal transformation, (*morphosis*, Fries), and becomes a mass of blue-black, bur-like spores, covered with a dry fragile rugose cortex, which is but slowly disintegrated by wind and rain. The Fig. *6b* hardly represents the stout, pale fuscous strands of the capillitium.

IX. DIDYMIACEÆ.

Sporangia simple, single or plasmodiocarpous. Peridium simple and calcareous or double, when the outer wall only is calcareous. Columella short, hemispherical or wanting. Capillitium of thin colorless or purplish threads radiating from the columella or base of the fructification to the peridium, generally without lime, Spores violet-black.

KEY TO THE GENERA.

Peridial lime deposits, crystalline, ... DIDYMIUM.
Peridial lime deposits, amorphous granules, . CHONDRIODERMA.

DIDYMIUM, *Schrader*.

Sporangia distinct or plasmodiocarpous; peridium simple or double, the outer wall covered usually with calcareous scales, sometimes united to form a crust. Columella, the enlarged head of the stipe or wanting. Capillitium lime-free, delicate.

A large genus distributed throughout the world but represented in Iowa so far by but three species.

43. DIDYMIUM PROXIMUM, *Berkeley* and *Cooke*. Plate X, Figs. 4, *4a* and *4b*.

Sporangium nodding, globose farinaceous; the stipe attenuate upwards, luteous. Columella none; flocci pale, few. Spores pale violet, smooth, .007–.009.

Reported first as found on pine needles in South Carolina. Rostafinski adds: Peridia spherical umbilicate below, stipitate; stipes straight, rigid, ferruginous, produced in the interior of the peridium as a columella. Columella of varying shape. Capillitium of colorless threads, united in a loosely constructed net.

A beautiful little species occurring occasionally on dead leaves, etc., in September and later. Perhaps too near the next, from which it is distinguished by longer slender stem, spherical sporangium, and pale or colorless capillitium.

44. DIDYMIUM FARINACEUM, *Schrader*. Plate VII, Figs. 3 and 3*a*.

Sporangia distinct, gregarious, stipitate, hemispherical, applanate, umbilicate below. Stalk short, sometimes scarce visible. Columella hemispherical, filled with calcareous granules. Peridium thin, strewn with minute lime crystals. Capillitium of simple, fuscous, wavy threads. Spores spheroidal, spinulose fuscous, .010–.012.

Rare, in spreading colonies on bark of rotten stems. The plasmodium is said to be white. Several varieties are recognized according to the length of the stem, abundance of lime-crystals, shape of sporangium, etc. August—September.

45. DIDYMIUM MICROCARPON, (*Fries*) *Rostafinski*. Plate VII, Figs. 2, 2*a* and 2*b*.

Sporangia stipitate, spheroidal, covered with crystals, snow-white, umbilicate. Stem long, twice the diameter of the sporangium, striate black or rusty-yellow. Capillitium of simple violet-tinted threads in a loose net. Spores violet-tinted, nearly smooth, .005–.006.

Our specimens are very delicate and beautiful, snow white spherules, mounted on slender stalks scarcely impressing the base of the sporangium, hence hardly umbilicate. The

spores are minutely verruculose and larger than the size quoted would indicate, .008–.009. Rare, on fallen sticks, leaves, etc., in the fall. Decorah. Mr. Holway.

CHONDRIODERMA, *Rostafinski*.

Sporangia distinct or plasmodiocarpous, sessile or stalked. Peridium usually double, the outer wall charged with amorphous granules of lime or crust-like by their accumulation, splitting irregularly or stellately to reveal the remote, delicate, iridescent, lime-free inner wall. Columella usually present and well developed.

46. CHONDRIODERMA GLOBOSUM, *Persoon*. Plate VII, Figs. 5, 5*a* and 7.

Sporangia spherical or globose, attached by a narrowed base to the substratum, or resting upon a strongly developed hypothallus, white with lime. Outer peridium lime-white, brittle, the inner gray or iridescent. Columella usually very small, globoidal or ellipsoidal, snow-white as the hypothallus. Capillitium violet-tinted, made up of anastomosing threads; spores of the same color, minutely rough, .008.

The Chondriodermas are generally delicately beautiful. The outer wall in the present species is like finest unglazed china, softly smooth and yet not polished, absolutely white, with porcelanous fracture. An inter-parietal space separates the outer from the inner wall, so that the former may be broken, bit by bit, without in the least disturbing the underlying structure. The inner wall is ashen or gauzy iridescent green, sending back all colors in reflected light. The spores are violet, deeply so when fresh, the capillitium strong and likewise tinted, the columella passing down and blending with the common snow-white hypothalline base. Two distinct habits present themselves, represented in Figs. 5 and 7. In the one the distinct sporangia are associated but not

crowded; in the other all are massed together in quite æthalioid fashion, forming chalky masses of considerable size (two or three centimeters) where the sporangia are regular in shape and size by reason of mutual pressure. The plasmodium develops in forests and orchards, among decaying leaves. July—September. Not common.

47. CHONDRIODERMA TESTACEUM, *Schrader*. Plate VII, Figs. 4, 4*a* and 4*b*.

Sporangia spherical or hemispherical depressed, about 1 mm. broad. Outer peridium flesh-colored, at length white; the inner, very delicate, violet. Capillitium abundant, graceful, without thickenings. Spores dusky-black, very delicately warted, .008–.010.

Differs at sight from the preceding although found at the same season and in similar situations. Forms referred to this species are variable in form, save that all specimens show somewhat of flattening, or depression. The inner peridium tends to be wrinkled or rugulose. Colonies form along the veins and margins of dead leaves (oak) generally in a single series; very handsome. The freshly formed peridia have a roseate tint that lends an added charm. Decorah. Mr. Holway.

48. CHONDRIODERMA CALCAREUM, *Link*.

Sporangia sessile, circular, ovate, oblong or variously curved, convex, depressed. Outer peridium pale, hyaline when wet; white, shell-like, opaque, when dry, very fragile; at length breaking irregularly; inner peridium ashen, somewhat persistent. Capillitium scant. Spores black, compacted.

Recognized by its peculiar form and habit. The sporangia are flat, whatever their shape in contour, sometimes resemble flat plasmodiocarps. The outer peridium fits the inner closely and is very transient, so that in an entire colony the collector may find scarce a sign that such envelope ever had existence.

In habit this species is like the preceding; the sporangia are found commonly on leaves, living or dead, and take up their places along the edge of the leaf or follow its venation. A very neat little species. August.

49. CHONDRIODERMA FLORIFORME, *Bulliard*. Plate VIII, Figs. 1, *1a* and *1b*.

Sporangia globose, stipitate, borne on a well developed hypothallus, brown, shining. Peridium stout, at maturity opening in irregularly stellate fashion, displaying the black mass of spores and capillitium. Columella ovate, as if stipitate. Capillitium formed of many violet-tinted threads united as a net, with numerous nodules. Spores pale violet, with scattered spinules, .010–.011.

This is our common species, occurring in August and September, year by year, on oak logs and stumps far gone in decay, generally coming to fruit in dark cavities and holes, so that specimens are to be sought even beneath the surface of the ground. The sporangia are, as above described, at first spherical on a well developed, pale, alutaceous stipe. On exposure to the dry atmosphere of the laboratory or to the sun, the peridium breaks into segments which curl down about the top of the stipe and there persist long after the wind has scattered the sooty spores. The columella also persists, is of the same color as stipe and peridial wall, and associated with these organs offers a form to which the species doubtless owes its name—*floriforme*—flower-like.

X. PHYSARACEÆ.

Fructification either in form of distinct sporangia, plasmodiocarps or æthalia. Peridium simple or double. Capillitium of tubes or solid strands, with deposits of amorphous lime-granules, either at special points or throughout.

KEY TO THE GENERA.

A. Sporangia distinct or plasmodiocarpous.

a. Capillitium in part with strongly thickened spiniform branches.

* All the capillitial threads uniformly thickened and colored; the branches spine-like, ... CIENKOWSKIA.

* * Capillitium as if of two sorts, delicate, with occasional calcareous thickenings, and stout, consisting of calcareously thickened spine-shaped tubes, ... PHYSARELLA.

b. Capillitium uniform throughout.

* Capillitium generally thin, thread-like, widened here and there into vesicles which are charged with lime-granules.

1. Capillitial threads arising from a somewhat broad base, dichotomously branching, anastomosing, becoming thin at the free ends, ... TILMADOCHE.

2. Capillitial threads irregularly branched, netted, adherent to the peridial wall.

a. Peridium double; capillitium knots only in part calcareous, ... LEOCARPUS.

b. Capillitium knots generally calcareous.

† Peridium opening by a lid, . CRATERIUM.

† † Peridium opening variously, . PHYSARUM.

* * Capillitium calcareous throughout, ... BADHAMIA.

B. Sporangia combined to form large cushion-like æthalia, . . . FULIGO.

CIENKOWSKIA, *Rostafinski.*

Sporangia plasmodiocarpous. Peridia simple, opening irregularly. Capillitium with some of the branches free, these apiculate. Calcareous granules well developed, frequently branched.

50. CIENKOWSKIA RETICULATA, *Albertini* and *Schweinitz.* Plate IX, Figs. 6, 6*a* and 6*b*.

Sporangia plasmodiocarpous, creeping, reticulately interwoven, orange or brown. Capillitium with calcareous granules. Spores violet-tinted, smooth, shining, .009 in diameter.

Rare. Found in undisturbed woodland, in scanty colonies on dead leaves. Our specimens are clear orange-yellow under low magnifying power, somewhat rough. The capil-

litium is concolorous, in strong contrast to the dark black spores. It is pretty hard to prove that some of the capillitium branches are free, and consequently hard to see any reason for the existence of this genus. The spores measure .0105 and are very slightly roughened. August.

PHYSARELLA, *Peck.*

Peridia stipitate, cup-shaped, furnished with calcareous granules, the base, and hollow pseudo-columella persisting after the fall of the spores. Capillitium made up of pale filaments accompanied by four layers of spiniform tubes horizontally radiant; tubules with lime granules. Spores globose, smooth, brown-black.

51. PHYSARELLA MIRABILIS, *Peck.* Plate VIII, Figs. 4, 4*a* and 4*b*.

Sporangia stipitate, above sub-infundibuliform, slightly fibrillose or squamulose, yellowish-rusty; the base and false columella persistent. Stipe equal or scarcely conoid, rusty-brown. Capillitium of delicate filaments, here and there thickened and anastomosing, some of the tubes spiniform, extending horizontally between the peridial walls. Spores smooth, globose, brownish-black, .008 in diameter.

This species has been found here but once, on dead birch bark. The sporangia are variable in form. Some are stalked, cup-shaped, as described; others are entirely sessile, irregular, flabellate, or even spherical. The calcareous thickenings are bright yellow, especially the large very conspicuous spine-like structures which constitute the trabecular portion of the capillitium. The sporangia are usually large, some as much as one-eighth of an inch high.

P. mirabilis seems to be so far the only species and appears to be the same as *Tilmadoche oblonga*, B. and C. = *Trichamphora oblonga*, B. and C. in *Grevillea*, 1873.

TILMADOCHE, *Fries.*

Sporangia simple, stalked, breaking irregularly, without columella. Peridium very delicate, thin-walled, usually with calcareous granules. Capillitium lace-like, the tubules repeatedly dichotomously branched from the base, terminating by very delicate points in the peridial membrane; calcareous thickenings not numerous, spindle-shaped, small.

52. TILMADOCHE VIRIDIS, (*Gmelin*) *Saccardo.* Plate VIII, Figs. 8, 8*a*, 8*b* and 8*c*.

Sporangia globose, flattened or lenticular, beneath plane or concave, variously colored, yellow, greenish-yellow, rusty-orange, stipitate, nodding; the peridium splitting irregularly or reticulately. Stipe variable in length and color, through various shades of red and yellow, subulate. Capillitium strongly developed, concolorous with sporangium, the tubes with colorless, calcareous thickenings. Spores smooth, fuscous or violet-black, .008.

A very handsome and rather common little species, generally greenish-yellow in color, but occasionally brilliantly orange without a suggestion of green. The nodding, lenticular, umbilicate sporangium, barely attached to the pointed apex of the stipe is sufficient to distinguish the species. The spores in our specimens seem a trifle larger, measuring .009. August—September. On rotten logs in the woods.

53. TILMADOCHE GYROCEPHALA, (*Mont.*) *Rostafinski.* Plate VIII, Figs. 2, 2*a* and 2*b*.

Sporangia spherical or irregular, impressed, gyrose-confluent, helvelloid, umbilicate below. Peridium thin, ashy, covered with evanescent yellow squamules, fragile. Stipe from an expanded membranaceous base, long-subulate, yellow. Spores smooth, violet, .009–.011.

A most singular species and well defined is this, occurring

in masses of decaying leaves or in rotten logs. The plasmodium at first colorless; as it emerges for fructification white, then yellow, spreading far over all adjacent objects, not sparing the leaves and flowers of living plants; at evening slime, spreading, streaming, changing; by morning fruit, a thousand stalked sporangia with their strangely convoluted sculpture. The evening winds again bear off the sooty spores and naught remains but twisted yellow stems crowned with a pencil of tufted silken hairs. August.

LEOCARPUS, *Link.*

Sporangia sessile or short-stipitate. Peridium double; the outer thick, breaking stellately or irregularly, the inner very delicate, enclosing the capillitium with the spores. Tubes of the capillitium reticulately joined, the knots, some delicate filled with air, others with calcareous granules.

54. LEOCARPUS FRAGILIS, *Dickson.* Plate VIII, Figs. 3, 3*a* and 3*b*.

Sporangia gregarious or clustered, sessile or stipitate, obovoid, rusty or spadiceous yellow, shining. Peridium opening at maturity in somewhat stellate fashion. Stipe filiform, white or yellow, weak and short. Spores dull black, spinulose, .012–.014.

The only species; distributed through all the world, Iowa to Tasmania. Recognizable at sight by the form and color of the sporangia. In shape and posture these resemble the eggs of certain insects, and, occurring upon dead leaves, generally where these have drifted against a rotten log, they might perchance be mistaken for such structures. With no other Slime-mould are they likely to be confused. The outer peridium opens stellately, the divisions reflected as in No. 49, so that the entire structure simulates a flower. At center of the capillitium is a calcareous core. The plasmodium is yellowish-white, spread in rich and beautiful reticulations.

CRATERIUM, *Trentepohl.*

Sporangia stipitate, regular, cyathiform, opening with a lid, distinct. The peridium double or three-fold; the outer, continuous with the hollow stipe, papyraceous; the inner thin, without lime. Capillitium consisting of rigid persistent tubules, calcareous at base. Columella calcareous.

55. CRATERIUM LEUCOCEPHALUM, *Persoon.* Plate VIII, Fig. 5.

Sporangia ovate, stalked, the upper part rugose, mottled with white; the lower and stipe, rusty-brown. The lid pure white, strongly convex. Capillitium nodes and columella white.

The tiny cups which form the fruit in this species are in themselves sufficiently definitive. The outer peridium persists long after the spores are scattered. The columella, so called, is formed by strongly developed calcareous nodes of the capillitium, massed at the center, just as in No. 54. Not common; on leaves and fallen wood in forests.

PHYSARUM, *Persoon.*

Sporangia simple, plasmodiocarpous or æthalioid. Peridium simple or double, irregularly dehiscent, calcareous. Capillitium a uniform net, thickened and calcareous at the nodes, adherent on all sides to the wall of the inner peridium.

56. PHYSARUM DIDERMOIDES, *Acharius.* Plate IX, Figs, 1, 1*a*, 1*b* and 1*c*.

Sporangia sessile or short-stalked, crowded upon a common hypothallus, ovate or cylindric, persistent. Peridium double; the outer thin, colorless, early deciduous, the inner thick calciferous, white. Capillitium with white, round calcareous nodes. Columella none. Spores spinescent, dark-violet, .012–.014.

A very variable species. Our specimens do not agree in several particulars with the description above given, which is substantially that of Rostafinski. As will be seen from the plate, it is the *outer* peridium that is with us white and burdened with lime, the inner is simple and comparatively thin. The snowy outer peridium is however easily displaced. The colony may not show it at all, in which case the peridia remaining give to the fructification entire a pale lead color, very characteristic. The nodes of the capillitium are *not* generally round, and the spores in our specimens measure much larger than as quoted, viz: .016–.018, the largest spores we have seen. Withal a handsome and attractive species, not common. Found on decaying wood in August. Mr. Newton.

57. PHYSARUM CINEREUM, *Batsch.* Plate IX, Figs. 4, 4*a*, 4*b* and 4*c*.

Sporangia sessile, crowded, of different sizes, spherical elliptical or elongate, flattened. Capillitium strongly developed, richly supplied with large irregular angular calcareous nodes. Columella none. Spores smooth or finely punctate, .0075–.013, violet-black.

This delicate inconspicuous species is well defined by the characters given. It occurs not rarely on richly manured ground, in meadows, lawns, or even on the open prairie. The plasmodium may form rings several inches in diameter, scattered here and there over a surface several square feet in extent, in fruit ascending the blades of grass, completely covering these with the crowded sporangia. The color of the fruit is well described in the specific name, *cinereum*, ashen-gray. The spores are very delicately papillate.

58. PHYSARUM DITMARI, *Rostafinski.* Plate VIII, Figs. 7 and 7*a*.

Sporangia sessile, crowded or heaped, spherical, ovoid or elongate, yellow or greenish-yellow. Peridium thin, fragile.

Capillitium delicate, with rather small, irregular, yellowish, calcareous nodes. Columella none. Spores bright-violet, smooth, .0075–.009.

This beautiful species occurs more commonly on moss-tufts, with which it is frequently concolorous, or escaped upon dead leaves, etc. The peridium is flecked with calcareous scales or grains stained with yellow or green and to these the whole fruit owes its peculiar color. The color and aggregated, heaped sporangia are distinctive macroscopic characters.

58. PHYSARUM LEUCOPHÆUM, *Fries*. Plate IX, Figs. 2, *2a* and *2b*.

Sporangia stipitate or sessile, depressed, spherical, ashy-white bordering upon blue; stipes straight, anon connected, variable, brownish. Columella none. Capillitium delicate with numerous nodes, few calcareously thickened. Spores smooth, dull violet, .008–.009.

An exceedingly variable species; hard to identify from description merely. In Iowa a richly calcareous phase prevails, returning in plentiful abundance year by year. Sessile and irregular sporangia predominate, but the same plasmodium often yields sessile and stipitate, intergrading. The stipe when present is more often white than brown, and the spores are not smooth, but when highly magnified show the surface covered with minutest points. Habitat, on fallen trees of various sorts, chiefly and always to be found on the dead stems of *Populus grandidentata*, Mx. September—December.

59. PHYSARUM LEUCOPUS, *Link*. Plate IX, Figs. 7, *7a* and *7b*.

Sporangia spherical, ovoid or depressed, stipitate, cinereous. Stipe snow-white, occasionally borne upon a common hypothallus, of varying lengths, tapering upward, stiff, brittle, with

numerous longitudinal plications. Capillitium well developed, with abundant and irregular angular calcareous nodes. Spores black, spinulose, .009–.011.

Not common, on weather-beaten rails and stumps. Easily recognizable by the elegant white stipe which sometimes persists long after the fruit has been distributed by the winds. August — October.

60. PHYSARUM CONTEXTUM, *Persoon.* Plate IX, Figs. 3 and 3*a*.

Sporangia distinct, sessile, densely crowded, sub-rotund or reniform. Peridia double; the outer rather thick, calcareous, yellow, or white, the inner thin, yellowish. Capillitium containing numerous irregular calcareous granules. Columella none. Spores deep violet, .011–.013, covered with minute spinules.

This singular species occurs not rarely upon the bark of fallen twigs, upon bits of straw or grass-stems lying undisturbed upon the ground. In such a position the Slime-mould covers, as with a sheath, the entire substratum. The outer peridium, especially its upper part, is entirely evanescent; our Fig. 3, shows the sporangia with upper outer peridium wanting. Not rare in summer and autumn.

61. PHYSARUM SINUOSUM, *Bulliard.* Plate VIII, Figs. 6 and 6*a*.

Sporangia distinct or plasmodiocarpous, the plasmodiocarp creeping in long vein-like reticulations or curves, laterally compressed; sometimes distinct and crowded, always sessile. Peridium double; the outer thick, calcareous, fragile, snow-white; the inner delicate, the dehiscence by longitudinal fissure. Capillitium strongly developed with abundant white calcareous granules. Spores smooth, dull violet, .008–.009.

Very rare so far, but occurring now and then on the upper side of the leaves of living plants, a few inches from the ground; recognizable by outward characters. The two sorts of fructification often occur side by side, or merge into one another on the same plasmodium. Where the substratum affords room the plasmodiocarpous style prevails; in narrower limits the sporangia stand singly. The calcareous deposit on the outer peridium is very rich and under a lens appears made up of countless snowy or creamy flakes.

62. PHYSARUM ELLIPSOSPORUM, *Rostafinski.* Plate X, Figs. 3, 3*a* and 3*b*.

Plasmodiocarp long and widely effused, anon winding, here and there reticulate, always applanate, the peridial cortex membranaceous, firm, thick and white. Capillitium well developed, furnished with lime. Spores thin-walled, ellipsoidal, violaceous, plicate-rugose, .014–.016 × .011–.012.

Not common. Found occasionally in shaded situations on piles of rotting straw. The spores are, no doubt, many of them ellipsoidal; some are spherical; all are decidedly spinulose, perhaps might appear plicate-rugulose when dry or shrunken. Calcareous nodules very large and irregular, white. Reported from North America only.

63. PHYSARUM AURISCALPIUM, *Cooke.* Plate IX, Figs. 5, 5*a* and 5*b*.

Sporangia distinct, gregarious or crowded, sessile, ellipsoidal or compressed ovate, yellow. Peridium thin, opening irregularly. Capillitium well developed, reticulate, with abundant, yellow, calcareous, granular thickenings. Spores, .013–.015.

Specimens referred to this species correspond well with Mr. Cooke's description and figures except that in our material the spores measure only .009–.012. The peridial wall is

very delicate above, but persists below as a cup-shaped base after the spore-mass has entirely disappeared. The capillitium is a beautiful yellow, strongly contrasted with the rich black mass of spores. The curiously compressed sporangia are narrowly sessile, but not stipitate; have no hypothallus. July. Decorah. Mr. Holway.

BADHAMIA, *Berkeley*.

Sporangia simple. Peridial wall simple, thin, breaking irregularly. Capillitium formed of abundant, richly anastomosing tubules, filled throughout their entire length with calcareous granules; the nodes feebly represented.

64. BADHAMIA PAPAVERACEA, *Berkeley* and *Ravenel*. Plate X, Figs. 6, *6a* and *6b*.

Sporangia globose, short stipitate, crowded, white, rugulose. Capillitium reticulate, white. Spores black, .010, frequently obovate, granulate above, in clusters of about seven.

This beautiful species is rare. Small plasmodia occur on fallen oak in the deeper woods. The thin blue-white, rugulose peridia are exceedingly delicate, and quite characteristic. The spores are delicately warted, and tend to aggregate in small clusters; occasionally a single one appears, much larger, .012–.014.

65. BADHAMIA RUBIGINOSA, *Chevallier*. Plate X, Figs. 1, *1a* and *1b*.

Sporangia globose-turbinate, stipitate. Stipe slender, twice the sporangia, rusty-brown, smooth. Peridium smooth, somewhat shining, purplish-brown, opening by a somewhat regular fissure as by a lid. Capillitium well developed, white. Columella more or less distinct, formed of the intruding stipe. Spores delicately warted, violaceous, .012–.015.

Our common species and rather common Slime-mould. Found in September and October on dead twigs, leaves, etc., in the woods. The sporangia are rather compact, stout, persistent little structures, easily recognized by the unaided eye. The capillitium is strongly developed, rigid, snow-white, the spores fuscous, variable.

FULIGO, *Haller*.

Sporangia strand-like, intricately woven in and out among each other to form a large cushion-shaped, æthalioid mass. The outermost layer without spores, calcareous, forming a thick but fragile crust. The middle layer spore-bearing, provided with a calcigerous capillitium. The lowermost layer developed as a membranous hypothallus.

66. FULIGO VARIANS, *Sommerfelt*. Plate X, Figs. 2, *2a* and *2b*.

Plasmodium bright yellow. Plasmodiocarp brown or yellowish-brown, of variable size and shape, one to five inches in diameter, and one-half an inch to an inch thick, enclosed by a distinct calcareous crust which varies greatly in texture, thickness and color, anon brown, stout, persistent, sometimes thin, bright yellow, scarce recognizable. Capillitium well developed but variable in color and extent. Spore-mass dull black, sooty. Spores spherical, purplish-brown, smooth, .007–.010.

Very common in summer, June to September, everywhere. On sultry summer days the yellow plasmodium may be found abundant, streaming over rotten straw or other refuse, about barns, wooden pavements, walks, etc., even in towns and near the homes of men. In the woods likewise abounding; on rotten logs, stumps, leaf-heaps, everywhere; in fruiting, climbing from its nutritive base and occupying some elevated position, several feet up on the stem of a living tree, for instance. In

such a case the cortex and hypothallus are generally well developed; the yellow or yellowish-green varieties are more commonly if not always found fruiting where they grow. In size the æthalia seem limited only by the condition of adequate food-supply. Specimens one foot in diameter have been reported. Our largest plasmodia spread over perhaps a foot square; our largest fruiting mass is four inches by two and one-half.

This completes our present list for this locality. Doubtless its length may soon be greatly increased, perhaps be even doubled. Much material unclassified and unarranged must wait a wider leisure. Meantime the author will hope the assistance of his fellow botanists, at least in Iowa, that this long-neglected field may become, with passing seasons, better and better known, alike to the increasing delight of those who find pleasure in the beauty of natural objects, and to the furtherance of biologic science in this State.

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SCHRŒTER, DR. J., *Die Natuerlichen Pflanzenfamilien, Engler and Prantl; Myxogasteres.*

STRASBURGER, DR. EDOUARD, *Zellbildung und Zelltheilung.*

WINTER, DR., *Die Pilze.*

ZOPF, DR. W., *Die Pilzthiere oder Schleimpilze.*

Special thanks are due to Mr. J. B. Ellis, whose unwearied patience has sufficed to meet all drafts upon his kindness during a course of years; to Dr. Geo. Rex, whose letters and specimens have been most helpful; to Prof. A. P. Morgan, for constant similar assistance; to Mr. E. W. D. Holway, Mr. B. Shimek, Prof. G. W. Newton, Prof. L. H. Pammel, Miss Mary Linder, for material collected; to Prof T. J. Burrill and Prof. C. E. Bessey, for literature; and finally to Miss Mary McBride, to whose artistic skill is owing whatsoever advantage our present effort may possess by reason of the accompanying illustrations.

REPORT ON SOME FOSSILS COLLECTED IN THE NORTHWEST TERRITORY, CANADA, BY NATURALISTS FROM THE UNIVERSITY OF IOWA.

By S. CALVIN.

A party of students under the direction of Professor C. C. Nutting, of the University of Iowa, spent the summer of 1891 collecting specimens of Natural History in the territory of the Hudson Bay Company, north of Lake Winnipeg. In the part of the collection submitted to me are some interesting geologic specimens, embracing fragments of a light-colored, fine grained dolomite, together with representatives of two species of *Favosites*, two Cyathophylloid corals one of which is probably a Streptelasma, and one species of *Pentamerus*. As usual in dolomitic limestone the fossils, when not silicified, are preserved as casts, and for this reason the specific relations of the corals cannot be definitely determined. One species of *Favosites* however, is not distinguishable from casts of a small-celled variety of *Favosites favosus* Goldfuss, a variety that has frequently been referred to *F. niagarensis* Hall. The other has corallites about the size of those of *F. hispidus* Rominger.

The *Pentamerus*, which is an exceedingly interesting, symmetrical species, was described by Mr. J. F. Whiteaves, Paleontologist of the Canadian Geological Survey, in the *Canadian Record of Science* for April, 1891, under the name *Pentamerus decussatus*. It is about as large as *P. oblongus* Sowerby, and like that species is very variable in shape and size. Like *P.*

oblongus too it was extremely prolific, so much so that portions of the beds are crowded full of casts that interlock and intersect with one another to such an extent as to make it difficult to obtain a perfect specimen. One peculiarity of these casts is that while the original shell substance has been dissolved and carried away, a fine grained material resembling the dolomitic matrix has been substituted in its place, retaining all the markings of the original surface and giving us practically perfect casts of the exterior of the shell. On some of the specimens the thin layer that took the place of the original shell, scales off in places and reveals the internal cast. The species may be described as follows:

PENTAMERUS DECUSSATUS *Whiteaves.*[1] Plate XI, Figs. 1–3; Plate XII, Fig. 2.

Shell rather large, very variable both as to size and shape; average forms subovate, widest in front of the middle, moderately convex; anterior margin sinuous with the middle somewhat abruptly produced.

Dorsal valve convex in the umbonal region, flattened or even concave from side to side toward the front; beak projecting into foramen of other valve; no hinge-area.

Ventral valve much more convex than the dorsal; most convex at the umbo, but arching somewhat regularly from beak to front margin; middle of valve occupied by an imperfectly defined subangular ridge; two other ridges, one on each side mid-way between the median ridge and the lateral margins sometimes faintly defined, sometimes obsolete; beak incurved; foramen broadly triangular, its base occupied by beak of dorsal valve; hinge-area imperfectly defined.

Median septum on interior of ventral valve very short as compared with *P. oblongus*, rarely extending much beyond the umbo; V–shaped pit, moderately large; the two septa of dorsal valve fairly well developed.

1 Pentamerus decussatus, (sp. nov.) Whiteaves, *Canadian Record of Science*, April, 1891, p. 295, Plate III, Figs. 3 and 4.

Surface of both valves marked by numerous, rather fine, rounded, radiating costæ, having an average width of about one millimeter; costæ increasing chiefly by bifurcation; radiating markings crossed by finer concentric ridges averaging about half the width of the costæ, and by numerous, often sharply pronounced, lines of growth.

The concentric striæ are not equally well developed on all individuals, nor are they always equally well developed on all parts of the same individual. Some individuals are extremely gibbous, others are narrow and elongate.

An average specimen has a length of two and a half inches, with a width of a little less than two inches, and a thickness of one and three-eighths inches. An elongate, strongly arched form has a length of more than three inches and a width about one and three-fourths inches.

Collected near the Hudson Bay Company's station, Grand Rapids, at the northern end of Lake Winnipeg, by Frank Russell and Arthur G. Smith. The geological horizon is Upper Silurian, the strata being probably the equivalent of our Niagara limestone.

Since the collections made by Messrs. Russell and Smith came to hand, I have received specimens of this species showing slightly different characteristics, obtained from bowlders in drift near Virden, Manitoba.

TWO UNIQUE SPIRIFERS FROM THE DEVONIAN STRATA OF IOWA.

By S. CALVIN.

The two spirifers illustrated on Plate XII of the present Bulletin are already known to geologists. Descriptions of them have for some time been before the public, but hitherto no figures of them have been published.

SPIRIFERA URBANA *Calvin.*[1] Plate XII, Figs. 1 and 1*a*.

The description of this species will be found in Vol. I of this Bulletin, page 28. The figures on Plate XII, show the outlines and general characters very faithfully, but they do not exhibit the obscure plications on each side of the mesial fold and sinus as clearly as they are seen in the original specimen.

The specimen figured was found in Devonian shales, usually referred to the age of the Hamilton group, near Iowa City, Iowa. The species is known to occur in the central part of Linn county.

SPIRIFERA MACBRIDEI *Calvin.*[2] Plate XII, Figs. 3, 3*a* and 3*b*.

The following is the original description of this species, slightly altered:

Shell medium size, more or less pyramidal or cyrtina-form; hinge line equal to greatest width of shell, cardino-lateral angles scarcely produced. Ventral valve sub-pyramidal, hinge area very wide and slightly concave, the plane of the area forming an acute angle with a plane passing between the valves. Mesial sinus broad, shallow, with a low, rounded ridge down the middle. Dorsal valve slightly convex, mesial fold well defined, regularly rounded, protruding in front in the middle line owing to the ridge in mesial sinus of opposite valve. From twelve to fourteen low, rounded plications on each side of the mesial fold and sinus; plications large near the middle of the shell and decreasing in size towards the lateral margins. Entire surface very finely granulose; the granules in some places, particularly on mesial fold and sinus, being arranged in close-set, radiating lines. Imbricating lamellæ and lines of growth are crowded concentrically on the anterior half of each valve.

1 Spirifera urbana, Calvin. *Bulletin from Laboratories of Natural History* of State University of Iowa; Vol. I, p. 28. January, 1889.

2 Spirifera macbridei, Calvin. *American Journal of Science.* Vol. XXV, p. 433. June, 1883.

Length 23 mm., width 36 mm., height of hinge area 16 mm., width of foramen at base 10 mm.

This fine species, which is named in honor of Professor T. H. McBride, of the State University of Iowa, is found somewhat sparingly distributed in the Rockford shales of Devonian Age, at Rockford and Hackberry Grove, Iowa.

NOTE ON EXPEDITION TO BRITISH AMERICA.

By C. C. NUTTING.

During the summer of 1891, Mr. A. G. Smith and Frank Russell, and Prof. C. C. Nutting, of the State University of Iowa, were engaged in zoölogical explorations on the shore of Lake Winnipeg and on the lower Saskatchewan river. The results of this expedition have not yet been worked up for publication, but this opportunity is taken to acknowledge the valuable aid and facilities rendered the party by the B., C. R. & N. R. R., the various Canadian officials with whom the expedition came in contact, Capt. Wm. Robinson, of West Selkirk, Manitoba; the officers in charge of the Winnipeg Station of the A. Booth Packing Co., of Chicago, and the various agents of the Hudson Bay Company in the regions visited.

PYRGULOPSIS SCALARIFORMIS, (Wolf) Call and Pilsbry.

(PLATE XIII.)

By B. SHIMEK.

In the *American Naturalist* for January, 1886, Mr. H. A. Pilsbry reported the discovery of a form of *Pyrgula scalariformis*, Wolf, near Rock Island, Ill., for which the varietal name *mississippiensis* was proposed.

In a paper read before the Davenport Academy of Natural Sciences,[1] February 20th, 1886, Messrs. Call and Pilsbry describe the same form under the specific name *mississippiensis*, and refer it to the new genus *Pyrgulopsis*, which is therein proposed, together with typical *P. scalariformis*, Wolf.

In both papers this mollusk is treated as modern, although the statement is made in the latter that "many dead specimens have been taken, but as yet, no living ones." Acting under this impression, the writer, some two years ago, visited the locality in which Mr. Pilsbry made his discovery, with the determination to find living specimens of this interesting little mollusk, if possible.

Numerous bleached specimens were found along the east arm of Rock River, on the sand-bar (*d*, Fig. 1), but the dredge failed to bring up any living examples above this point. An examination of the bank between the points *a* and *b* (Fig. 1) however revealed a number of interesting facts, not the least of these being the presence of great numbers of

1 *Vide*, Proc. D. A. N. S., Vol. V.

the *Pyrgulopsis* in the loose talus of sand lying at the foot of the bank.

It wil be observed upon an examination of Fig. 1, that the current in this arm of Rock River impinges upon the bank between the points *a* and *b*, and that consequently this portion of the bank is not now receiving, nor has it recently received, additions, but on the contrary is being eroded by the current.

This fact led the writer to believe that the numerous bleached shells of the species in question which were found in the talus (*d* Fig. 2) were not recently deposited by the stream but that they formed a portion of the broad alluvial deposit which extends far to the north from the points mentioned.

A careful examination of the deposit during this and subsequent visits confirmed this belief. Sections were made at numerous points between *a* and *b*, (Fig. 1) along the face of the bank which is here about seven feet above low water, and three borings[1] were made respectively, 40, 50, and 150 feet from the edge of the bank in the vicinity of the point *c*, Fig. 1.

All of these sections gave substantially the same results, and the one figured (Fig. 2) which was made near the point *c*, Fig. 1, will serve as a type, and clearly shows the structure of this alluvial deposit. It consists of three more or less distinctly defined strata. The uppermost stratum, (*a*, Fig. 2) about three feet in thickness, consists of very fine, rich, black alluvium in which are found a few shells of *Mesodon*, *Succinea*, *Limnæa*, *Physa*, etc., the species being almost exclusively *Pulmonata*.

The second stratum (*b* Fig. 2) about two feet in thickness, contains an admixture of the materials of the first and third strata, the relative proportions varying however. There is also a corresponding mixture of the shells of the two strata.

The third stratum, (*c*, Fig. 2) which was penetrated to a depth of four feet, consists of pure sand and fine gravel, and

1 A seven-inch post-hole auger, attached to sections of gas-pipe, was used.

contains great numbers of fresh-water mollusks, the distinctively fluviatile forms such as Lamellibranchs, (*Sphærium*, *Pisidium*, and occasionally *Unio*), and the operculate *Gasteropoda*, (*Campeloma*, *Pleurocera*, *Amnicola*, *Pyrgulopsis*, *Somatogyrus*, etc.,) forming by far the greater proportion.

Some parts of this stratum are almost entirely made up of bleached shells.

In this stratum were found numerous specimens of the species under discussion, and though careful search was made none were found in places other than those to which the shells could easily be carried by the waters of Rock River from this deposit.

The following list of the shells found associated with the *Pyrgulopsis* may be of interest:

LAMELLIBRANCHIATA.

Sphærium striatinum, Lam.
Sphærium sulcatum, Lam.
Pisidium abditum, Hald.
Unio———fragments.

GASTEROPODA.

PROSOBRANCHIATA.

Pleurocera subulare, Lea.
Bithynella obtusa, Lea.
Amnicola limosa, Say.
Amnicola cincinnatensis, Anth.
Amnicola sayana, (?) Anth.
Somatogyrus subglobosus, Say.
Somatogyrus integer, Say.
Pomatiopsis lapidaria, Say.
Valvata tricarinata, Say.
Valvata bicarinata, Lea.
Vivipara intertexta, Say.
Campeloma subsolidum, Anth.
Campeloma coarctatum, Lea.

PULMONATA.

Zonites radiatulus, Alder.
Zonites minusculus, Binn.
Succinea ovalis, Gld.
Limnæa reflexa, Say.

Zonites arboreus, Say.
Zonites indentatus, Say.
Mesodon multilineata, Say.
Mesodon clausa, Say.
Mesodon profunda, Say.
Pupa contracta, Say.
Pupa pentodon, Say.
Succinea obliqua, Say.
Succinea avara, Say.
Limnæa caperata, Say.
Limnæa humilis, Say.
Limnœa desidiosa, Say.
Physa gyrina, Say.
Planorbis trivolvis, Say.
Planorbis parvus, Say.
Segmentina armigera, Say.
Ancylus rivularis, Say.

A total of thirty-eight species.

All of these species are now found living either in the immediate vicinity of of this deposit, or in the Mississippi and its tributaries not far away, the *Pyrgulopsis* being, so far as we know, the only extinct species which occurs in the deposit.

The fact that this species is a fossil led the writer to further compare it with *Pyrgula scalariformis*, which was described by Mr. John Wolf in 1869[1] as a "post-pliocene fossil."

The result of this comparison establishes the identity of *P. scalariformis* and *P. mississippiensis* beyond all doubt.

Mr. Wolf's description[2] is as follows:

"Shell turreted, slender; whorls six, chalky-white; suture deeply impressed; carinate its entire length on the lower edge of the whorls; mouth small, ovate, but slightly connected with the last whorl. Length one-half inch. Post-pliocene; abundant on the Tazewell shore of the Illinois river."

For comparison the description of *P. mississippiensis* is added.[3]

"Shell minute, pupiform, elevated, imperforate; whorls 5½–6, flattened, with a well-marked carina on lower third, which becomes central on periphery of last whorl, body-whorl equal to one-half entire length of shell and bluntly angulated

1 *Am. Journal of Conchology*, Vol. V, p. 198.

2 Copied in *Proc. Dav. Acad. of Nat. Science*, Vol. V, p. 14, from the *Am. Jour. of Conchology*, Vol. V, p. 198.

3 *Proc. Dav. Acad. Nat. Science*, Vol. V, p. 13; 1886.

at position of carina; epidermis———; suture distinct, deeply impressed only at commencement of last whorl and below, above last whorl covered by carina; aperture narrowly ovate, broadly rounded before and narrowly rounded behind, very oblique; peritreme continuous, almost rimate, slightly reflected over the parietal wall; lip simple, sharp." (Call and Pilsbry.)

In commenting on *P. mississippiensis*, Messrs. Call and Pilsbry say: "It differs in important particulars from the *P. scalariformis*, Wolf, which is 'carinate its entire length,' has a different aperture, and is markedly different in the character of the sutures. Our species is ecarinate on all whorls above the body-whorl, the carina being depressed and filling entirely the suture. The outlines of the apical whorls are wholly unlike the figured type of Wolf's species. The average measurements of the four specimens upon which the preceding description is based are, for length,[1] 4.66 mm.; for breadth 1.61 mm."

The writer has collected more than 1500 of these little snails, and a careful comparison of the specimens in this large series shows that the characters which are cited above as distinguishing between *P. mississippiensis* and *P. scalariformis* are not constant and have no specific value.

Four specimens of this series are represented in Fig. 3.

Of these *a* and *b* are more nearly typical *scalariformis*, while *c* and *d* are the forms included in *mississippiensis*. The series however is an unbroken one, the species varying from the ecarinate forms which are scarcely angled at the periphery of the body-whorl, and in which the suture is not impressed (*d*, Fig 3) to forms in which the carina is elevated and extends quite to the apex, and in which the suture is deeply impressed. (*a*, Fig. 3.) The form of the aperture also varies with the prominence of the carina, and in some specimens the

1 The dimensions of these four specimens, as recorded separately, show that the average length is 3.46 mm. instead of 4.66 mm. Probably a typographical error.

body-whorl is somewhat detached at its termination, thus answering to Wolf's description.

The statement that "the outlines of the apical whorls are wholly unlike the figured type of Wolf's species" is only partly true. While the latter does not accurately represent the apex it is not "wholly unlike" that of the strongly carinate form. The apparent difference is due to the inaccuracy of the drawing rather than to any difference in the specimens.

In Wolf's description as quoted above, the length is given as *one-half* inch. This is evidently a mistake as Mr. Wolf informs the writer that his specimens average *one-eighth* of an inch, thus agreeing with the dimensions represented on the plate with the figure of the type.

These facts collectively convinced the writer that *P. scalariformis* and *P. mississippiensis* are the same. In this opinion he was confirmed by the receipt of a small lot of shells from the original set which Mr. Wolf kindly forwarded. These leave no longer any doubt concerning the identity of the two "species."

If then we adopt the new genus *Pyrgulopsis* the name will stand: *Pyrgulopsis scalariformis*, (Wolf) Call and Pilsbry.

*   *   *   *   *   *   *   *

The section represented in Fig. 2 is of much interest from a geological standpoint.

As already noted in the preceding, the lowermost stratum, *c*, is composed of sand and gravel, the finer sand being mingled with great numbers of shells which belong almost exclusively to fluviatile genera. This was evidently an old sand-bar upon which were heaped the thousands of shells while it still lay in the path of a strong current,—a fact indicated by the coarse material as well as by the shells. These shells were carried but a short distance from their muddy habitats, and are in a fair state of preservation.

The middle stratum, *b*, was probably deposited while the strong currents of flood-times alternated with the more slug-

gish currents at lower water, and we find a consequent mingling of coarse and fine material, as well as of the shells deposited under somewhat different conditions in the strata *a* and *c*. The uppermost stratum, *a*, consists of very fine alluvium, rich in carbonaceous matter, and containing some fossils belonging to genera which live on land, or in ponds and shallow, sluggish waters.

This was evidently deposited during over-flows by the stream which had previously receded from the old sand-bars and flats now represented by *b* and *c*. During floods the water, laden with fine silt, spread, or backed up, over the lowlands on which it entrapped the mollusks which lived upon the land, or in the shallow ponds, in a deposit of fine alluvium. Very few shells other than those which occur in such habitats are found in this deposit, and their similarity to the shells of the Lœss formation is striking. Is it not probable that a considerable portion of our Lœss was deposited under similar conditions, which however were more favorable on the whole to the deposition of larger quantities of fine silt, the country being less eroded and hence less broken and the rivers receiving more water and spreading out over larger areas?

Like the stratum *a* the Lœss consists of fine material which is usually *unstratified* and *unlaminated*. The fossils of the two deposits are nearly the same. The difference in color is very marked, *a* being black and the Lœss a light yellow, but is it not extremely probable that the carbonaceous matter, which once probably formed an equally marked constituent of the Lœss, was consumed in the deposition of ferric oxide which occurs in spots, streaks, and bands in all of the fossiliferous portions of the deposit?

The similarity of these two deposits is certainly striking.

NOTES ON KARYOKINESIS.

By L. B. ELLIOTT.

So little comparatively is known of the process of cell-division in the plants of our region that the following notes may be of interest.

The karyokinetic figures described by Strasburger and others are found in great abundance in the dividing nuclei of the mother cells of *Botrychium virginianum*, Schwz. Since the process of division is one of very short duration it is not always possible to select a specimen of just the right age; but by taking those of the fertile fronds which are just unrolling it is reasonably certain that somewhere the cells will be found in the right condition.

After thoroughly hardening by soaking in alcohol, at first weak, then increased to the full strength, the pinnæ should be picked off and placed in a mixture of equal parts, alcohol and ether, for forty-eight hours, after which celloidin may be added. As the celloidin slowly dissolves, the spaces between the now somewhat shrunken mother-cells and the wall of the young sporangium will become filled. Thin sections can then be cut and the cells will not drop out and be lost.

Much time may be saved by mounting several pinnæ flat on the same cork. A section from this mount will give all the characters of several pinnæ at once.

The youngest cells will be found, of course, in the pinnæ at the end of the frond and in the sporangia at the end of the pinna.

It seems that the sporangium is at first divided into four compartments after the manner of an ordinary homosporous fern, and these persist until about the time when the division of the nuclei of the mother-cells is completed. The mother-cell-nuclei also divide into four, each of which develops into a spore, and it is during this division that the karyokinetic figures appear. After a little practice the condition of the nuclei can be estimated at a glance, even without staining, by the presence or absence of the partition wall or the tetrads.

There are only a few stains that are at all suitable for the demonstration of the structure of the nucleus. Perhaps the best of these is Friedlander's (haltbar) hæmatoxylin, both on account of its permanence and the extreme delicacy of its differentiating power. In order to secure the best results the sections should be placed in a shallow glass dish large enough to admit of their being well separated, and washed in water to remove the alcohol. A considerable amount of distilled water should then be added and the stain, which has been prepared by diluting with fifty to one hundred times its volume of distilled water, poured in and thoroughly diffused. The amount of stain used should vary, not with the amount of water used to immerse the sections, but with the amount of material to be stained. If the right quantity has been taken, the vegetable tissue only will be stained and not a tinge of color will appear either in celloidin or water, after the sections have remained in the solution for twenty-four hours, the time required to obtain a good clear color. Only two or three drops of the concentrated hæmatoxylin solution will be required to stain the sections cut from a single mount. If more is used the section will be overstained. Understained sections can be brought to the right color by adding a drop or two of stain to the water after it has become clear.

Even slight acidity of the alcohol used in hardening or the presence of organic impurities in the water makes perfect staining an impossibility.

Indirect division of the nucleus is not confined to the repro-

ductive cells of ferns or flowering plants but is frequently met with in the stalk of the sporangium (*Botrychium*); and karyokinetic nuclei in all stages of division, although not in great abundance in any one field, may be found in the meristemic tissue in the tips of the young shoots of conifers. The leaf buds should be collected in the spring after growth has begun. Sections in the region of the scale-like leaves will present nuclei which may be studied even under the one-fifth objective.

Botanical Laboratory, S. U. I., May, 1892.

A GEOLOGICAL RECONNOISSANCE IN BUCHANAN COUNTY, IOWA.

By S. CALVIN.

In October, 1891, the writer in company with Mr. G. L. Houser made a careful examination into the geological structure of portions of Buchanan county, Iowa. A part of the same region had been rather hurriedly examined a few months earlier, and the results of that preliminary work had been published, September, 1891, in the *American Geologist*, Vol. VIII, p. 142. A few errors were made, as usual, in the hasty preliminary observations, the only one of any consequence being that which is corrected in the *Geologist*, Vol. IX, p. 345.

The object in view in re-examining the region was to determine more carefully than had before been done the stratigraphical relations of the various beds of the region; to ascertain the relative position and vertical range of the several fossil species, the species in this locality being conspicuously associated in groups and confined to horizons of limited vertical extent; and lastly to find in place if possible the beds containing *Renselaria johanni*, or *Newberrya johannis* as it is now called, and so fix its horizon, a point which had been left undetermined in the previous examination.

The work was begun at Independence, and a large number of exposures of Devonian strata in and around the city were examined. About a mile east of the city the beds are folded and disturbed to a slight extent, and at one locality in the bank of a small stream the *Gyroceras beds*,—No. 3 of the section published in the *Geologist* for September, 1891,—were exposed. At this locality some of the layers associated with the Gyroceras beds were found to be completely brecciated, and, in all respects relating to composition and structure, identical with the breccia exposed in the bed of the river below the city bridge. There were also here some indications, though not altogether satisfactory, of the *Independence shales*,—No. 2 of the sections mentioned above,—cropping out from beneath the breccia. The breccia in the bed of the river was next examined for some distance below the bridge and some of the fragments were found to contain *Gypidula occidentalis*, Hall, a species that occurs often in consideral numbers in intimate association with the large Gyroceras from which the assemblage of beds immediately overlying the *Independence shales* was named.

From one to two miles below the city of Independence the river turns abruptly to the east along the base of a rocky bluff some fifty or sixty feet in height. The face of the bluff is partly sodded over, but in general, and particularly a few feet above the level of the water in the stream, the rocks are well exposed. The Gyroceras beds proper appear here about six or eight feet above the water, and may be traced for a distance of nearly half a mile. In places these beds with the associated layers above and below them for a thickness of fifteen feet or more are broken into small fragments, mixed in the most promiscuous manner conceivable, and re-cemented into a solid bed of breccia. In other places the fragments are several feet or even several yards in diameter and evidently very much disarranged. For several rods in a few instances all these strata, elsewhere so generally converted into breccia, retain their original position without sign of disturbance.

Below the brecciated Gyroceras and Gypidula beds there are indications in a few instances of the Independence shales.

A few quarries opened in the bluff facilitate the work of observing the succession of strata. One of these quarries near the western end of the exposure has been worked down until the upper surface of the brecciated beds is now exposed. For a distance of thirteen feet above the breccia the rocks are made up of soft, light-colored, imperfectly stratified, argillaceous limestones which are practically destitute of fossils and were therefore in the field notes designated as the *Barren beds.* These barren beds grade upwards without lithological change of any importance into the *Spirifera pennata beds* as described and limited in the *American Geologist* for September, 1891. No beds higher than the *S. pennata beds* were seen in this locality.

As intimated above the *S. pennata beds*, like the Barren beds, are composed of soft, light-colored, argillaceous limestones. The layers are a little more compact and more regular than those immediately below them. Some of the layers included in this part of the section are barren; but fossils characteristic of the horizon are found both above and below them. *Spirifera pennata* Owen, does not range throughout its whole thickness; but taking the assemblage of layers together, *S. pennata* Owen, is its most conspicuous fossil. The fauna of these beds contains a number of unsatisfactory casts of two or three species of *Paracyclas*, one large, orbicular form being probably identical with *P. elliptica* Hall. There are also a few *Polyzoans*, but the fauna is conspicuously composed of *Brachiopoda.* The most common forms are *S. pennata* Owen; *S. bimesialis* Hall; *Cyrtina hamiltonensis* Hall; *Atrypa reticularis* Linnæus; *A. aspera* var., *occidentalis* Hall, var.; *Orthis impressa* or *O. iowensis* Hall; *O. macfarlanei* Meek; *Strophodonta demissa* Conrad; *Productella subalata* Hall. A few straggling specimens of *Gypidula occidentalis* Hall, occur at this horizon; and, occuring even more rarely, are specimens of *Athyris vittata* Hall, a *Rhynchonella* of the

R. cuboides type identical with *R. intermedia* Barris, and a large *Chonetes* which I propose to call *C. cancellata*.

I have said that *Spirifera pennata* does not range through the entire series of beds to which its name is here attached. It is in reality confined chiefly to the upper portion of the beds. In the quarry at the west end of the bluffs described above, the uppermost layers exposed are lower than the horizon of this large spirifer. A quarry recently opened near the eastern end of the bluff includes spirifer-bearing layers that are geologically higher than any layers in the west quarry.

The pennata beds are well developed in quarries within the city limits of Independence, about a quarter of a mile east of the court house. The same beds are exposed in a number of quarries from a mile to a mile and a half farther east. It was in one of these quarries about a mile east of the city that the *Independence shales* were penetrated in an unintelligent search for coal. The first shaft that reached the shales was made by Mr. Kilduff, in the bottom of a quarry that had previously been worked well down into the Barren beds. The shaft before it reached the shales passed through the *Gyroceras beds*, but at the point where the excavation was made these beds appear not to have been brecciated.

In all the quarries about Independence the S. pennata beds pass up into harder layers containing few brachiopods, but holding numberless specimens, unsatisfactory for cabinet purposes, of *Cystiphyllum americanum* Ed. and H. A few other corals, as for example *Favosites dumosus* Winchell, *Favosites placenta* Rominger, *Alveolites minima* Davis, and very sparingly *Heliophyllum halli* Ed. and H., are associated with Cystiphyllum. In some of the quarries east of Independence, beds containing *Acervularia profunda* Hall, are found to occupy a position immediately over the horizon of *Cystiphyllum*; and the whole assemblage of coral-bearing layers, from the horizon at which the Cystiphyllums begin to the summit of the layers containing *Acervularia profunda*, has been called *Acervularia profunda beds*. That magnificent coral, *Phillip-*

sastrea gigas Owen, occurs in a few restricted areas about Independence, in or near the horizon of *Acervularia profunda. Acervularia davidsoni* Ed. and H. is found occasionally in the drift or other superficial deposits, evidently weathered out from strata that originally held a position higher than any seen in place in the vicinity of Independence.

At Littleton, ten miles northwest of Independence, there are exposures on both sides of the river containing groups of fossils of exceptional interest. The only rocks seen in place between Independence and Littleton are exposed at Otterville, and belong to the horizon of the Spirifera pennata beds. At an old ford a short distance below the village of Littleton the beds containing *Acervularia profunda* Hall, are seen above the level of the water. They may be traced almost to the mill on the east side of the river. A few belated individuals of *Spirifera pennata* Owen, are occasionally found in them, but when found at this horizon the form differs markedly from the average forms in the typical pennata beds. The individuals are unusually large, very robust, and they have the hinge-area disproportionately wide. The same gibbous form with wide hinge-area was collected at the same horizon in the quarry east of Jesup.

At the "dry run," a mile east of Littleton, the fauna of the A. profunda beds has been freed from its enclosing matrix by the erosion of torrents that at certain times sweep down the usually dry channel. In addition to *A. profunda*, which is there very common, the fauna contains *Cystiphyllum americanum* Ed. and H., *Cyathophyllum*, *Aulocophyllum*, *Favosites dumosus* Win., three other species of *Favosites*, *Alveolites goldfussi* Bill., a species of *Alveolites* with corallites larger than in *A. goldfussi*, and another very unique species with corallites less oblique than usual and a strongly developed central tooth on the inner side of each tube. There are also *Dolatocrinus*, undetermined species, *Cladopora palmata* H. and W., *C. prolifea* H. & W., two or three species of Stromatoporoids, one or two of *Aulopora* and a peculiar *Syringo-*

pora. On the west side of the river, about a quarter of a mile below the dam at Littleton, *Newberria johannis* Hall, was found in place. It is confined to a thin layer of yellow, shaly limestones which lies immediately above layers containing *Acervularia profunda* Hall, and it may be convenient to regard this yellow calcareous shale as the uppermost limit of the sub-division which is here called the Acervularia profunda beds. In the same thin layer with *Newberria johannis* H., there occur *Terebratula romingeri* H., and *Pentamerella arata* H.

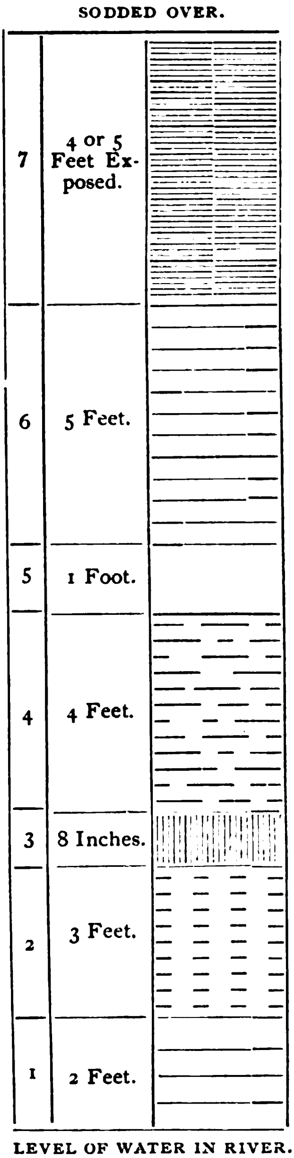
Immediately above the calcareous shales containing *Newberria*, the fauna undergoes a very marked change. *Spirifera parryana* H., takes the place of *S. pennata* Owen. *Atrypa aspera* is absent. *A. reticularis* has become more ventricose, with cardino-lateral angles more rounded and the radiating costæ much coarser than in the *A. reticularis* of the pennata beds. *Strophodonta demissa* Con., becomes very large, having in mature specimens a width of two inches at the hinge-line with a length of more than an inch, and presents an appearance very different from the small, short hinged, arcuate, coarsely ribbed forms, rarely more than three quarters of an inch in width, found associated with *Spirifera pennata*, at Independence. The layers containing *S. parryana* are followed by a compact reef of *Acervularia davidsoni* Ed. and H., with which are associated *Favosites*, *Ptychophyllum*, *Cladopora* and some other genera. The beds included between the calcareous shale containing *Newberria* and the summit of the reef of *Acervularia davidsoni* and associated corals, constitute the *Acervularia davidsoni beds*.

On the west side of the river at Littleton, near the end of the mill dam and for some distance below it, the rocks above the reef of *A. davidsoni* are yellow colored, indurated shales which grade up into softer shales that readily weather on exposure into a yellow clay mixed with harder fragments that resist the action of the weather. The harder layers in the lower part of this division of the section contain no fossils as

far as observed, but the softer shales in the upper part of the exposure, on both sides of the river, contain a number of species all very perfectly preserved. The most conspicuous are a spirifer with a divided mesial fold and having a hinge-area narrower than *S. parryana*, a very diminutive *Cyrtina hamiltonensis*, a small *Athyris vittata*, a very coarsely ribbed *Atrypa reticularis* having the dorsal valve excessively convex, a large form of *Strophodonta demissa*, an *Orthis impressa* of the type *O. suborbicularis*, *Productella truncata*, a small *Rhynchonella*, and a *Terebratula*. Besides the brachiopods we find, though rarely, *Megistocrinus farnsworthi*, and very many specimens of *Striatopora* (*Cladopora*) *iowensis*.

The following section and explanation was furnished Prof. James Hall at his request, and was published in the *Tenth Annual Report of the State Geologist of New York*. It will illustrate the relations of the strata as they are exposed below the mill at Littleton. 1, 2 and 3 of this section are the equivalent of No. 5 of my paper in American Geologist of September, 1891; 4 and 5 equal 6 of that paper, and 6 and 7 equal 7.

SECTION ON WEST SIDE OF WAPSIPINICON RIVER, ABOUT ONE-QUARTER MILE BELOW THE DAM, AT LITTLETON, IOWA.



7. Yellow argillaceous shales with large *Strophodonta demissa*, a very coarsely ribbed *Atrypa reticularis*, a small *Cyrtina hamiltonensis*, *Striatopora rugosa*, *Orthis suborbicularis* related to *O. impressa*, *Terebratula* sp?, a small *Rhynchonella*, *Athyris vittata*, rare, a well marked variety of *Spirifera parryana*, probably a new species, etc.

6. A bed of indurated shales, somewhat barren of fossils.

5. Compact reef of *Acervularia davidsoni*, with many species of *Favosites*, a *Chonophyllum*, *Cladopora prolifera* and *C. palmata*.

4. Rather hard, dark granular limestone, with *Spirifera parryana*, large, long-hinged, *Strophodonta demissa*, *Atrypa reticularis*.

3. Thin layer of yellow shaly limestone, with *Newberria johannis*, *Terebratula romingeri* and *Pentamerella arata*.

2. Beds containing *Cystiphyllum*, *Acervularia profunda*, a few specimens of *Spirifera pennata* Owen.

1. Limestone with *Cystiphyllum americanum*.

The shaly layers last described, some barren and some containing beautifully preserved remains belonging to a great number of organic species, make up the *Yellow shales beds*, No. 7, of the section published in the *Geologist*, September, 1891. A mile or more above Littleton the yellow shales with their characteristic fauna are exposed in the bank of the west branch of the Wapsipinicon. The exposure is at the foot of a bluff sixty or seventy feet in height, and outcroppings at different elevations in the bluff show that the beds up to the summit are yellow calcareous shales, hard enough with the exception of a few layers near the level of the water, to resist the action of the weather. No organic remains were observed in the bluff except in the few feet of soft shales near the base. All the strata of the bluff belong properly to the Yellow shales beds, and when added to what is exposed below the mill at Littleton, they give to this member of our Devonian section a great predominance, so far as thickness is concerned, over all the others thus far noted in this paper. West of Jesup, in the edge of Blackhawk county, the Acervularia beds are seen in place. At Waterloo the same beds are exposed. At Raymond, between Jesup and Waterloo, quarries are worked in a hard yellowish calcareous shale which I take to be the equivalent of that part of the Yellow shales beds exposed above the base of the bluff near Littleton.

Between Littleton and Fairbank no rocks were seen in place. A quarry on the west side of the stream at Fairbank, contains thick bedded strata the exact relations of which were not ascertained. The rock is an impure limestone with a considerable admixture of clay. The fauna is scanty, consisting chiefly of a *Cystiphyllum* of unknown species and one or two species of *Newberria*. Specimens of *Acervularia* weathered from higher beds were found on the surface but no diagnostic species were seen in place. Neither the Cystiphyllum nor the Newberrias could be said to be absolutely identical with any known species. A mile or two up the stream, at a place called Cedar Bluffs, rocks are exposed, but they reveal

facts that have not before been recorded, nor even suspected in connection with Iowa geology. The Cedar Bluffs are made up of Niagara limestone, *Heliolites interstinctus*, *H. megastoma*, *Lyellia americana*, *Favosites hispidus*, *F. niagarensis* and other Upper Silurian species are here more or less common. The rocks too have the characteristic color, texture and composition of the Niagara strata in Delaware, Jackson and other counties in which the Niagara limestone has long been known to be exposed.

Rocks belonging to the lower part of the Devonian in Iowa are well developed at Fayette. The same strata are again exposed in the southeast corner of Buchanan county. Omitting the irregularities caused by erosion, a line joining the points named, it was supposed, would coincide very nearly with the Devonian outcrop. Such a line however would pass at least fifteen miles to the east of Fairbank. For the facts as now known, the only explanation thus far suggested, is that after the close of the Niagara period, probably early in the Devonian, an anticlinal fold was developed in the neighborhood of Fairbank, having a general trend east and west. While this *Niagara uplift* as we may call it, was not very great, it will be seen, if we draw a line from Fayette to Fairbank and thence to the southeast corner of Buchanan county, that it was sufficient to cause a very pronounced and unexpected deflection in the line of Devonian outcrop. At Fairbank the line will be bent at a right-angle. Such a line may be compared with that which marks the eastern edge of the Devonian area in White's Geological Map of Iowa. On the geologic maps of Iowa, Hazelton, ten miles east of Fairbank, lies well within the Devonian area; but at Hazelton as would be expected after the observations made at Fairbank, the exposures are all in the Niagara limestone and *Favosites favosus*, *Zaphrentis stokesi*, *Thecia minor*, and other Niagara species were collected in addition to the species found at Cedar Bluffs near Fairbank. Near Coytown, about two miles northeast of Hazelton, the upper part of the exposures

is made up of a non-fossiliferous, light-colored, fine-grained limestone that breaks with a conchoidal fracture and possesses characteristics of lithographic limestone.

It is quite possible that the Niagara uplift is in some way connected with the agency that produced such extensive brecciation in the lower beds of our Iowa Devonian.

Attention was next directed to the exposures in the south-eastern part of Buchanan county. At Pine Creek mill, between Independence and Quasqueton, the exposure in the south bank of the stream embraces the Barren beds observed near Independence, overlaid with the lower part of the S. pennata beds *Atrypa reticularis* of the Independence type, *A. aspera*, var., *occidentalis*, and casts of *Paracyclas elliptica?* constitute the observed fauna.

Below the mill dam at Quasqueton the Brecciated beds are well exposed on both sides of the river. On the east bank the Independence shales crop out from beneath the breccia, the line of junction being marked by a series of small springs. At Gemmel's quarry, up on the high land a mile and a half east of the river the strata belong to the Acervularia davidsoni beds. *Spirifera parryana* H., which varies considerably in different localities, is present with the rest and coincides in external appearance and expression with the forms found at Hanson's and other typical localities in Muscatine county.

At Troy mills, just beyond the southern edge of Buchanan county, the strata are brecciated beds in the channel of the river with *Gyroceras*, *Gypidula*, and the forms usually found in such association; the breccia is followed by barren beds that break up into angular fragments on exposure to the weather; then come the S. pennata beds, but not very well developed; above the last lie beds with *Phillipsastrea gigas* Owen, in place; and the section here is terminated by beds containing *Acervularia davidsoni* and *Spirifera parryana*.

At Troy mills, *Acervularia profunda* H., appears to be absent. Careful search at its usual horizon and in the weath-

ered material along the bluff failed to reveal a single specimen. The place it occupies farther north seems to be taken by *Phillipsastrea gigas* Owen, which is here somewhat abundant. *P. gigas* was once very common a few miles northeast of Troy mills, at what are known among the old settlers as the Walton and McPike springs; and good specimens may still be collected in the same localities. *P. gigas* and *A. profunda* were found weathered out in ravines near the river above Quasqueton. The first is known to occur there in place, the second may possibly occur in the same way. At Solon, in Johnson county, Iowa, *P. gigas* is found in its normal position a few feet above beds that are the equivalent of S. pennata beds at Independence, but no specimens of *A. profunda* are known in any part of the region. *A. profunda* seems to have been confined to a limited area in Buchanan and Blackhawk counties, its center of distribution being near Littleton.

The rectified section of Devonian strata in Buchanan county embraces the following members, each of which may be still farther sub-divided:

1. *Independence shales*, with a unique fauna having a very close relationship with the Rockford shales along Lime Creek above Rockford, Iowa.
2. *Brecciated beds*, embracing the beds characterized by *Gyroceras* and numerous usually detached valves of *Gypidula occidentalis.*
3. *Barren beds.*
4. *Spirifera pennata beds*, characterized by the abundance of easily recognized types of *Spirifera*, *Atrypa*, and *Strophodonta.*
5. *Acervularia profunda beds*, containing Cystiphyllum and *A. profunda* in great profusion.
6. *Acervularia davidsoni beds* beginning with the beds con-containing *S. parryana*, and including all up to the summit of the reef of *A. davidsoni* and associated corals.

7. *Yellow shale beds*, containing a peculiar and easily recognized assemblage of fossils described in the present paper and in the *American Geologist* for Sept., 1891.

The *Newberria johannis* H., which in a former paper was thought to occupy a distinct series of beds, was found at the summit of the horizon characterized by a *A. profunda.* The relations of the beds containing the undetermined species of *Newberria* near Fairbank, are yet undetermined. The Niagara uplift near Fairbank is a fact new to Iowa geology, and its full effects in deflecting the regular trend of Devonian outcrop and modifying the regular succession of Devonian strata have yet to be ascertained.

NOTES ON A COLLECTION OF FOSSILS FROM THE LOWER MAGNESIAN LIMESTONE FROM NORTHEASTERN, IOWA.

By S. CALVIN.

Until recently we have been accustomed to regard the Lower Magnesian Limestone of the Upper Mississippi Valley as destitute of organic remains. Dr. White in his report on the Geology of Iowa, Vol. I, pp. 173–174, says that "the only fossils that have been found in this formation in Iowa are, so far as known, a few traces of the stems of Crinoids found near McGregor." Whitney in Hall's Geology of Iowa, p. 337, speaking of indications of organic life in the Lower Magnesian Limestone, says that "in Iowa, indeed, we have observed nothing of the kind." Owen seems to have been more fortunate than the other observers mentioned, for in his report on the Geol. Survey of Wis., Iowa and Minn., p. 60, he enumerates a few genera that are represented in this for-

mation, but does not cite localities. The *Euomphalus* and *Ophileta* which he mentions, may be from the horizon of the Lower Magnesian Limestone of Iowa; the trilobites referred to are probably from the Upper Potsdam or St. Croix group as will be noted farther on. In the Geology of Wisconsin, Vol. IV, Whitfield describes a number of species from the Lower Magnesian Limestone, but it is probable that the only species referable to the horizon of the formation in Iowa is his *Euomphalus strongi* which he says occurs in cherty beds in Richland county, Wisconsin. In the Geology of Minnesota, Final Report, Vol. I, pp. 222-223, Prof. Winchell mentions the discovery of organic remains in limestone of the same age as our Lower Magnesian. The fossils occur only in cherty beds and embrace the genera *Orthoceras*, *Ophileta* and *Pleurotomaria*.

In all discussions relating to the fauna of the Lower Magnesian Limestone of Wisconsin, Iowa and Minnesota, it should be borne in mind that for many years geologists have confounded the St. Lawrence Limestone, a member of the Potsdam or St. Croix series, with the Lower Magnesian. In the Geology of Minnesota, Final Report, Vol. II, pp. xiv to xxii, Prof. Winchell gives the results of the latest investigations on this subject and points out the true relations of the long misunderstood St. Lawrence Limestone. It is possible that all the species of *Dicelocephalus*, *Conocephalites*, *Illænurus*, and other forms associated with them, which have been credited to the Lower Magnesian Limestone, have come from the St. Lawrence Limestone and belong to a horizon below that of the Lower Magnesian.

Within the past few years Mr. F. H. Luthe, an enthusiastic and intelligent amateur geologist, of McGregor, Iowa, has investigated the fauna of the Lower Magnesian Limestone of Clayton and Allamakee counties, and has brought to light an assemblage of forms of very great interest. Mr. Luthe has kindly placed his collection in my hands for examination. All the recognizable species belong either to the Gasteropoda or

Cephalopoda. Indeed all the species belong to one or the other of the above groups except some amorphous, laminated, porous structures that recall certain forms of the *Stromatoporoidea.*

The following species, all apparently confined to cherty layers of the formation, may be noted:

METOPTOMA ALTA *Whitfield.* The collection contains specimens apparently identical with the species described and figured by Mr. R. P. Whitfield under the above name in his paper on *Fossils from the Calciferous Sand-rock of Lake Champlain*, Bulletin of Am. Museum of Natural History, Vol. II, No. 2. The Iowa specimens referred to this species are larger than those from Lake Champlain. With the above occur two or three other species of *Metoptoma.*

TRIBLIDIUM, sp. There are a few forms presenting the appearance of *Capulus* or *Platyceras* that probably belong to this genus.

STRAPAROLLUS CLAYTONENSIS n. sp. This is by far the most common species in the collection. It resembles *Euomphalus calciferus*, Whitfield, Lake Champlain Fossils, p. 47, Plate VIII, Figs. 12 and 13. The volutions are four or more in number, circular in transverse section; umbilicus wide and deep; spire sometimes almost flat, usually slightly elevated. From *E. calciferous* W., this species will be distinguished by the fact that the volutions, in the cast, are not embracing, scarcely touching each other, and the volutions are not coiled in the same plane. The two forms are about equally robust and the whorls expand at about the same rate. *Straparollus claytonensis* differs from *Euomphalus strongi* Whitfield, in the greater number of less rapidly expanding volutions, the absence of carinæ or angles on the whorls and the pronounced difference between the umbilical and opposite sides.

STRAPAROLLUS PRISTINIFORMIS, n. sp. This is a smaller form than the preceding; volutions less robust, not embracing

or slightly separated in the cast, coiled in the same plane so that the spire and umbilical sides are similar in appearance; whorls nearly circular in transverse section, upper surface of each marked by an obscure carina, with traces of another carina still more obscure half way between the middle of the whorl and the suture.

RAPHISTOMA PEPINENSE *Meek*. The collection contains many specimens of this very beautiful species. The spire is depressed and consists of about six volutions in specimens having a diameter of one inch. The periphery is sharply angulated and the umbilicus wide when compared with other species of the genus. Compare *R. trochiscum* Meek, in U. S. Exploration of the Fortieth Parallel, Vol. IV. p. 19.

RAPHISTOMA MULTIVOLVATUM, n. sp. Shell moderately large, more than an inch and a quarter in diameter; spire depressed; whorls five or more in number, increasing gradually in size, each about one and a half times as large as the preceding; each whorl bears an obtuse angular carina near the suture; suture somewhat deeply impressed; upper surface of each whorl concave; outer margin marked by a sharp angle from which the convex lower surface of the last whorl slopes downward and inward to the angle that bounds the umbilicus.

RAPHISTOMA PAUCIVOLVATUM, n. sp. This is a small lenticular species having from two to two and a half very rapidly expanding whorls.

HOLOPEA TURGIDA *Hall*. There are a number of specimens indistinguishable from this species as it is described and figured by Hall, Billings and Whitfield. See Paleontology of N. Y., Vol. I, p. 12, Plate III, Figs. 9 and 10; and Lake Champlain Fossils, by Whitfield, p. 50, Plate 9, Figs. 3–7.

MURCHISONIA, sp. There are a few specimens referable to this genus. They are characterized by an elongate spire with many sharply angular volutions.

ORTHOCERAS PRIMIGENIUM *Vanuxem*. This species is well represented by two or three specimens, all showing the characteristics by which it may be readily distinguished. See works of Hall and Whitfield already cited.

CYRTOCERAS LUTHEI, n. sp. Shell rather small, elliptical in transverse section, only moderately curved; length of an average specimen from two and a half to three inches, greatest diameter of body chamber three-fourths of an inch; septa very numerous, ten chambers occupying the space of half an inch; septa oblique to the axis, rising highest on the convex side, the obliquity increasing as the septa approach the chamber of habitation; siphuncle large for the genus, situated close to the inner or concave margin, tapering more rapidly in proportion to size than the shell, and expanding to a trifling extent between the septa. Outer chamber long; margin of aperture and surface markings unknown. This species will be readily recognized by its elliptical section, its oblique, closely crowded septa, and its large, internal, rapidly tapering siphuncle.

The specific name is given in honor of Mr. F. H. Luthe, of McGregor, Iowa, to whose skill and enthusiasm science is indebted for valuable additions to our knowledge of the fauna of the Lower Magnesian Limestone in the valley of the Upper Mississippi.

The collection contains fragments of other species that will sometime, we hope, be represented by identifiable specimens.

In general aspect this fauna resembles that of the Calciferous sand-rock about Lake Champlain. The identity of the species in some cases and the close resemblance in others, leaves little doubt as to the exact equivalency of the Lower Magnesian Limestone of Iowa with the Calciferous series of northeastern New York.

GEOLOGICAL LABORATORY,
UNIVERSITY OF IOWA,
May 25, 1892.

EXPLANATION OF PLATE I.

Enteridium rozeanum, Wing., p. 117.

Fig. 1. Æthalium, natural size.
Fig. 1*a*. Spore of the same species × 1400.
Fig. 1*b*. Capillitium of the same species × 420

Clathroptychium rugulosum, Wallr., p 117.

Fig. 2. Æthalium, natural size.
Fig. 2*a*. Sporangia and spores × 50 (after Schrœter).
Fig. 2*b*. Persistent apices of the peridia.

Lindbladia effusa, Ehr., p. 115.

Fig. 3. A group of sporangia × 30.
Fig. 3*a*. A single spore × 1400.

Tubulina cylindrica, Bull., p. 114.

Fig. 4. A group of sporangia × 5.
See also Plate VII., Fig. 8.

Cribraria intricata, Schrad., p. 119.

Fig. 5. Three sporangia, × 15.
Fig, 5*a*. A single sporangium, to show reticulate thickening, × 60.
Fig. 5*b*. A spore, × 1400.

**Dictydium cernuum*, Pers., p. 114.

Fig. 6. Sporangium, × 30.
Fig. 6*a*. A part of the peridial wall, seen from within, × 84

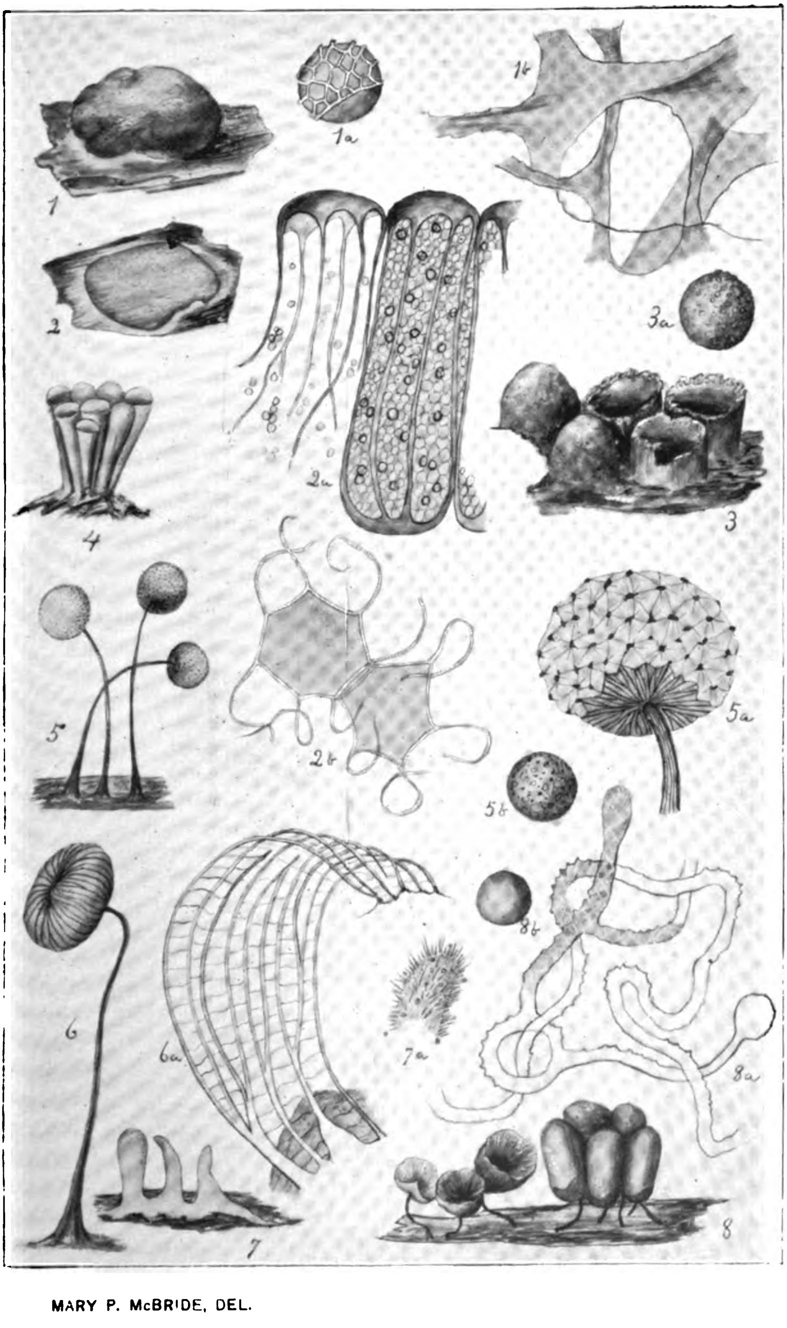
Ceratiomyxa mucida, Pers., p. 114.

Fig. 7. Three sporiferous pillars, × about 40.
Fig. 7*a*. Tip of a single pillar, × 84.

Hemiarcyria stipata, Schw., p. 135.

Fig. 8. Sporangia, × 6.
Fig. 8*a*. The capillitium of the same species, × 750.
Fig. 8*b*. A single spore, × 1000.

PLATE I.



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EXPLANATION OF PLATE II.

Perichæna corticalis, Batsch., p. 120.

Fig. 1. Sporangia, × 10.
Fig. 1*a* A single spore, as if in section, × 900.
Fig. 1*b*. The capillitial thread × 750.

Lachnobolus incarnatus, Alb. and Schw., p. 126.

Fig, 2. The sporangia × 8.
Fig. 2*a*. A portion of the capillitium × 750.
Fig. 2*b*. Spores × 750.

Arcyria cinerea, Bull., p. 123.

Fig. 3. The expanded fructifications × 5.
Fig. 3*a*. Tip of a single capillitium mass × 40.

Arcyria vitellina, Phillips, p. 124.

Fig. 4. A cluster of sporangia × 3.
Fig. 4*a*. Capillitium × 740.

Arcyria punicea, Pers., p. 123.

Fig. 5. Sporangia, two expanded, one still closed, × 20.
Fig. 5*a*. A part of the capillitium of the same species × 750.

Arcyria nutans, Bull., p. 124.

Fig. 6. Expanded capillitium, etc. × 10.
Fig. 6*a*. Capillitium × 740.
Fig. 6*b*. A piece of the capillitium thread × 1400.

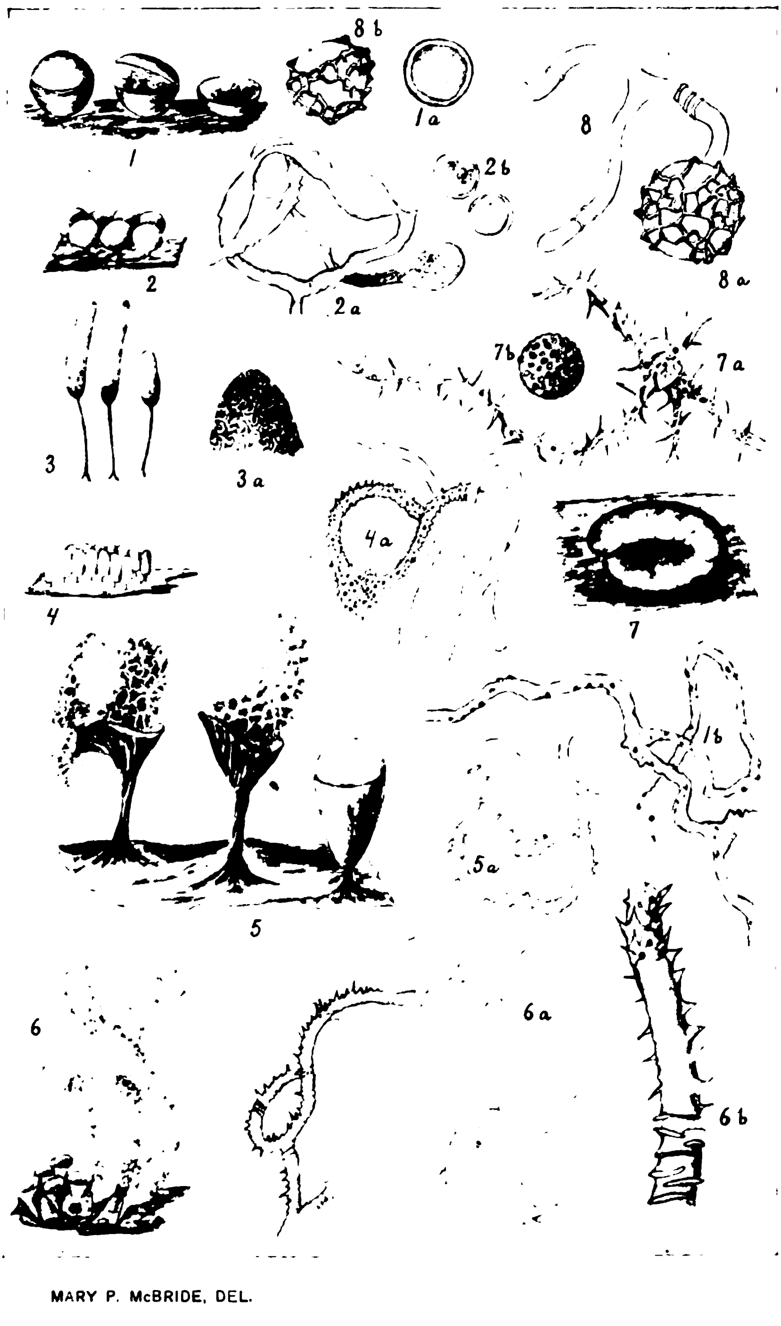
Cornuvia wrightii, B. and C., p. 122.

Fig. 7. A single sporangium × 8.
Fig. 7*a*. A node of the capillitial thread × 750.
Fig. 7*b*. A spore × 750.

Oligonema nitens, Lib., p. 121.

Fig. 8. A single elater × 750.
Figs. 8*a* and 8*b*. Spores × 1000.

PLATE II.



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EXPLANATION OF PLATE III.

Lycogala epidendrum, Buxb., p. 127.

Fig. 1. A group of æthalia, natural size.
Fig. 1*a*. A single spore × 1500.
Fig. 1*b*. A capillitium branch × 1000.

Lycogala flavo-fuscum, Ehr., p. 127.

Fig. 2. A single æthalium, natural size.

Reticularia lycoperdon, Bull., p. 136.

Fig. 3. A single æthalium, natural size.
See also Plate X.

Lamproderma arcyrioides, Somm., p. 138.

Fig. 4. Three sporangia × about 30.
Fig. 4*a*. Capillitium mass and stipe × 75.
Fig. 4*b*. Spores × 500.
Fig. 4*c*. Capillitium to show branching and anastomosing × 225.

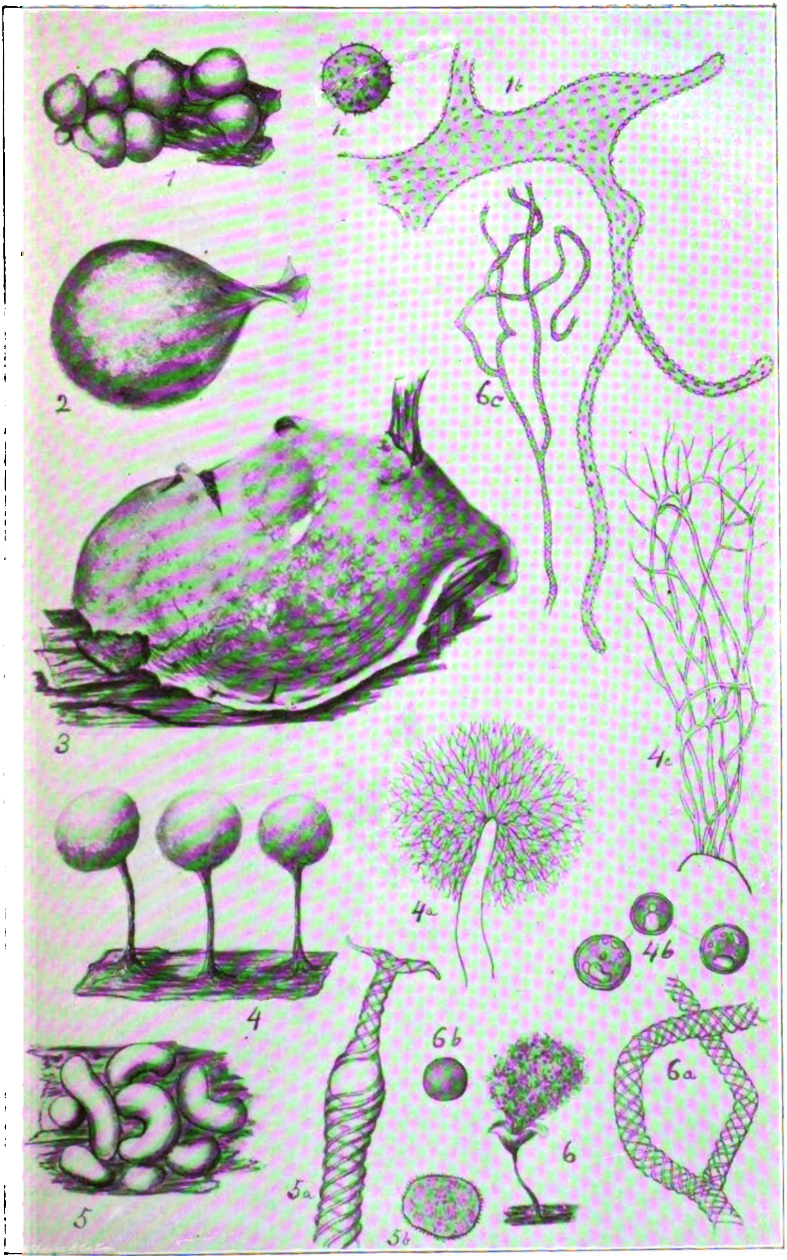
Trichia inconspicua, Rost., p. 132.

Fig. 5. Sporangia × 12.
Fig. 5*a*. Tip of an elater × 1400.
Fig. 5*b*. A single spore × 750.

Hemiarcyria clavata, Pers., var.

Fig. 6. A single sporangia × 15.
Figs. 6*a* and 6*b*. Spore and capillitium × 750.
Fig. 6*c*. A part of the capillitium × 200.

PLATE III.



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EXPLANATION OF PLATE IV.

Trichia affinis, De By., p. 131.

Fig. 1. Var. *intermedia* × about 6.

Fig. 1*a*. Spore of same species × 1400.

Fig. 1*b*. A second spore to show varying episporic net-work.

Fig. 1*c*. Tip of elater, shows vertical connecting bands.

Trichia fallax, Pers., p. 128.

Fig. 2. Sporangia × about 8.

Fig. 2*a*. A spore of the same species × 1400.

Figs. 2*b* and 2*c*. Elaters of the same species × about 225.

Trichia varia, Pers., p. 229.

Fig. 3. Sporangia × about 8.

Fig. 3*a*. A spore of the same species × 1000.

Fig. 3*b*. An elater of the same species × 750.

Trichia scabra, Rost., p. 132.

Fig. 4. Sporangia × about 8.

Fig. 4*a*. A single spore of the same species × 1400.

Fig. 4*b*. An elater-tip of the same × 1400.

Trichia chryrosperma, Bull., p. 130.

Fig. 5. Sporangia × about 8.

Fig. 5*a*. A single spore of the same × 1400.

Fig. 5*b*. A single elater-tip of the same × 1400.

Trichia affinis var. *abrupta*.

Fig. 6. An elater-tip × 1400. It will be noticed that the spirals *are* connected by vertical bars. See p. 131.

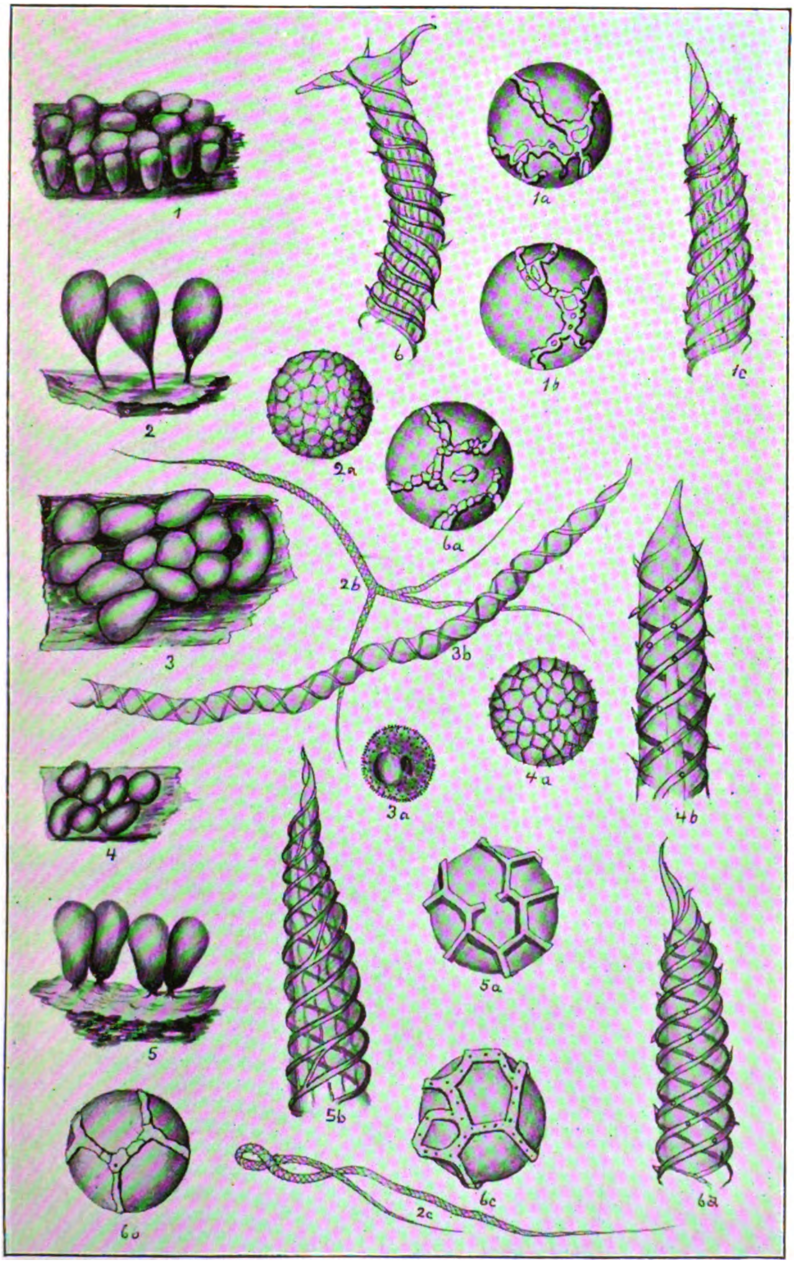
Fig. 6*a*. A single spore of the same variety × 1400.

Fig. 6*b*. A single spore, from the same sporangium as 6*a*.

Fig. 6*c*. *Trichia affinis*, var. *affinis*, a single spore × 1400.

Fig. 6*d*. Tip of an elater from the same, × 1400.

PLATE IV.



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EXPLANATION OF PLATE V.

Hemiarcyria rubiformis, Pers., p. 133.

Fig. 1. A cluster of closed sporangia × 15.
Fig. 1*a*. Tip of an elater × 1400.
Fig. 1*b*. A group of empty sporangia × 15.
Fig. 1*c*. A single spore × 1400.

Hemiarcyria clavata, Pers., p. 134.

Fig. 2. Three sporangia × 8.
Fig. 2*a*. The tip of an elater × 1400.
Fig. 2*b*. A single spore × 1400.

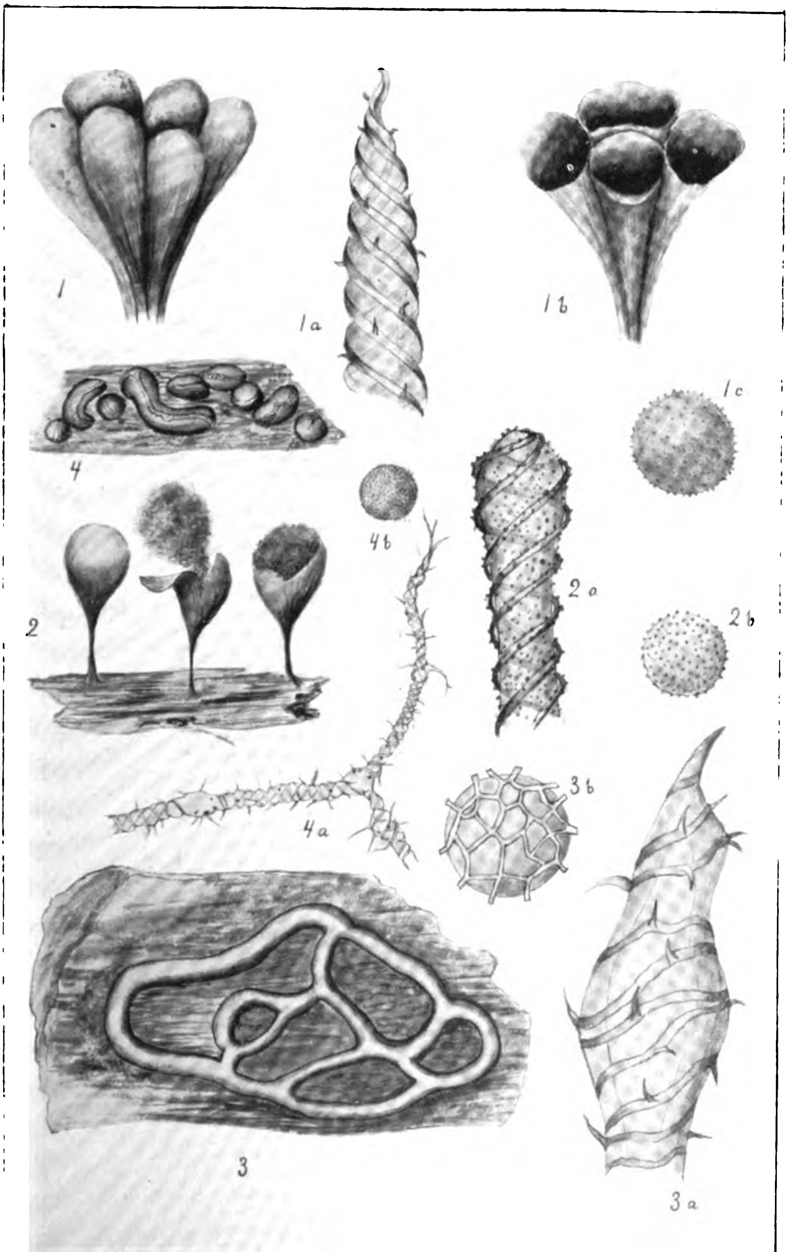
Hemiarcyria serpula, Scop., p. 135.

Fig. 3. A single plasmodiocarp × 5.
Fig. 3*a*. Tip of elater × 1400.
Fig. 3*b*. A spore × 1400.

Trichia iowensis, Macb., p. 133.

Fig. 4. Sporangia × 5.
Fig. 4*a*. Tip of a branching elater × 750.
Fig. 4*b*. A spore × 750.
See also Plate X., Fig. 5.

PLATE V.



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EXPLANATION OF PLATE VI.

Comatricha typhina, Roth., p. 138.

Fig. 1. A group of sporangia × 5.
Fig. 1*a*. A single spore × 1600.
Fig. 1*b*. Tip of the columella with its branches × 50.

Comatricha longa, Pk., p. 140.

Fig. 2. A single empty sporangium × 6.
Fig. 2*a*. A part of the same taken near the apex, × 60.
Fig. 2*b*. A spore × 1400.

Comatricha pulchella, Bab., p. 139.

Fig. 3. A single sporangium × 10.
Fig. 3*a*. The columella and capillitium × 60.
Fig. 3*b*. A single spore × 1600.
Figs. 3*c* and 3*d*, sporangia to which the peridium still adheres although in 3*c*, in shreds.

Stemonitis maxima, Schw., p. 141.

Fig. 4. A group of sporangia × 3.
Fig. 4*a*. A part of the columella and capillitium × 60.
Fig. 4*b*. A single spore. × 1400.

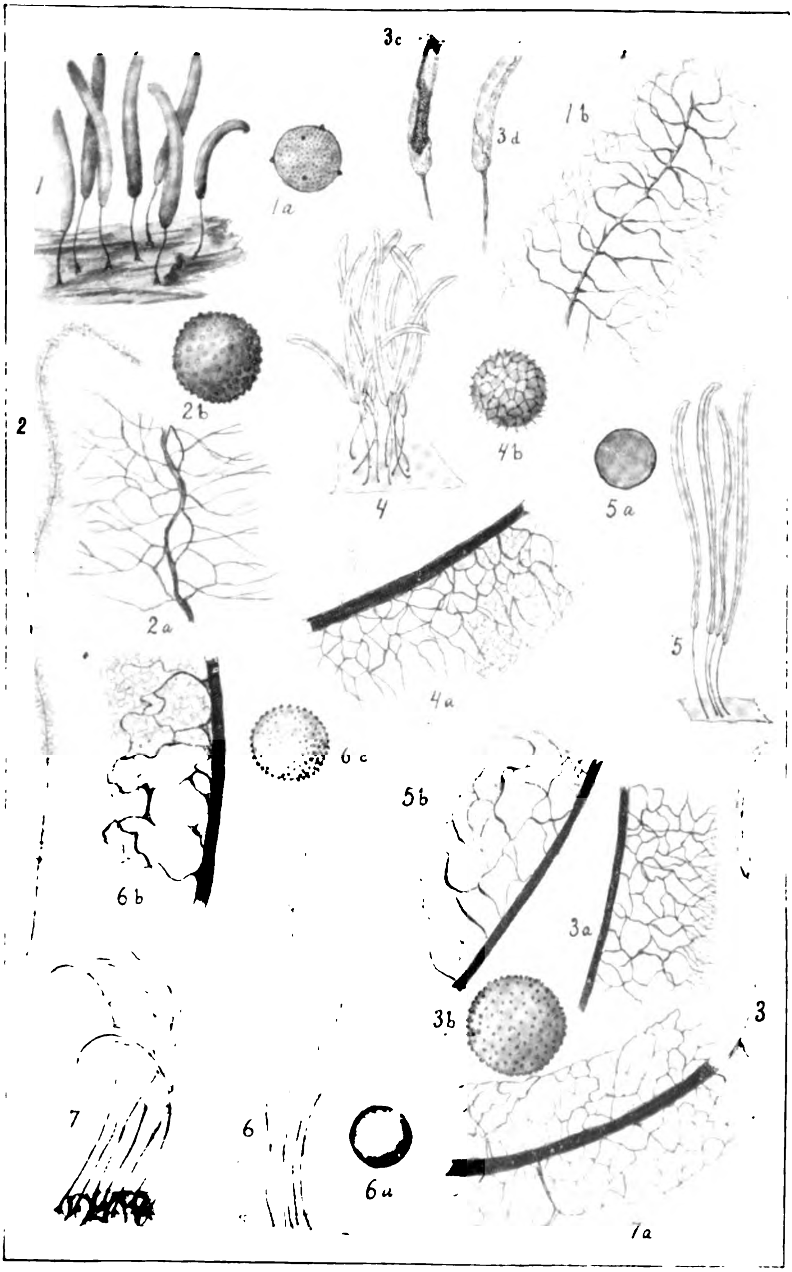
Stemonitis ferruginea, Ehr., p. 142.

Fig. 5. A group of sporangia × 3.
Fig. 5*a*. A single spore × 1400.
Fig. 5*b*. A part of the capillitium with columella × 60.

Stemonitis morgani, Pk., p. 142.

Fig. 6. A group of sporangia × 3.
Fig. 6*a* and 6*c*. Single spores, the latter × 1400.
Fig. 6*b*. A part of the columella and branches × 60.
Fig. 7. A shorter variety of the same species with coarser meshes in capillitium, × 3.
Fig. 7*a*. A part of the columella and net × 60.

PLATE VI.



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EXPLANATION OF PLATE VII.

Diachæa splendens, Pk., p. 143.

Fig. 1. Sporangia and hypothallus × 25.
Fig. 1*a*. Capillitium × 50.
Fig. 1*b*. Spores × 900.
Fig. 1*c*. Portion of the capillitium × 150.

Didymium microcarpon, Fr., p. 146.

Fig. 2. Sporangia × 30.
Fig. 2*a*. A spore × 1400.
Fig. 2*b*. Calcareous crystals from the peridial wall × 750.

Didymium farinaceum, Schrad., p. 146.

Fig. 3. Sporangia × 10.
Fig. 3*a*. A single spore × about 1000.

Chondrioderma testaceum, Schrad., p. 148.

Fig. 4. Sporangia; the first exhibiting the two peridial walls and the spore-mass × 10.
Fig. 4*a*. Spore × 750.
Fig. 4*b*. Capillitial threads × 750.

Chondrioderma globosum, Pers., p. 147.

Fig. 5. Sporangia; the first with the outer peridium broken away × 10.
Fig. 5*a*. A single spore × 750.
Fig. 7. A mass of clustered sporangia, to show habit of aggregation, natural size.

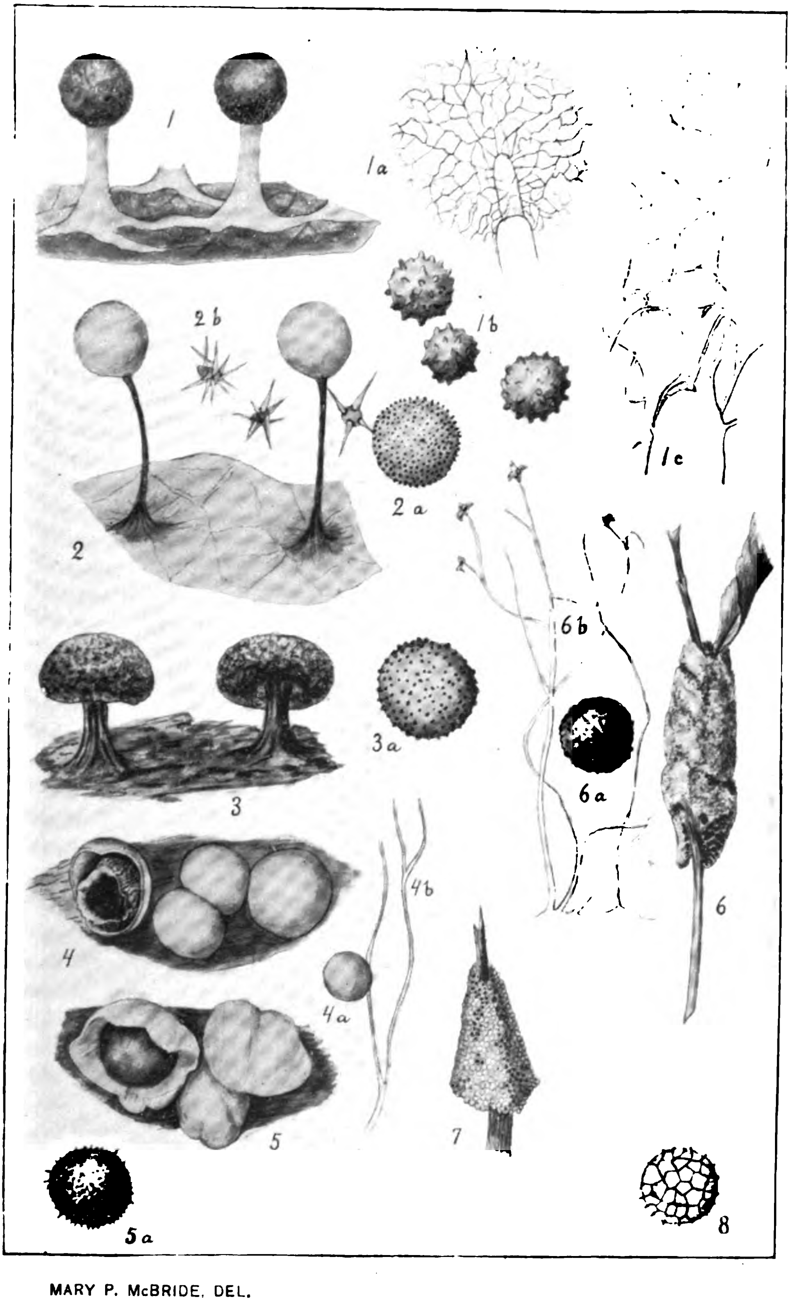
Spumaria alba, Bull., p. 144.

Fig. 6. An æthalium, borne on a grass-stem, natural size.
Fig. 6*a*. A spore × 750.
Fig. 6*b*. Capillitium, with surface calcareous crystals × 750.

Tubulina cylindrica, Bull., p. 114.

Fig. 8. A single spore × 1400.

PLATE VII.



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EXPLANATION OF PLATE VIII.

Chondrioderma floriforme, Bull. p. 149.

Fig. 1. Sporangia of various ages × 15.
Fig. 1*a*. Spore of the same species × 1000.
Fig. 1*b*. A capillitial thread × 1000.

Tilmadoche gyrocephala, (Mont.) Rost., p. 152.

Fig. 2. The sporangia × 10.
Fig. 2*a*. Spores × 750.
Fig. 2*b*. Capillitium × 750.

Leocarpus fragilis, Dicks., p. 153.

Fig. 3. Sporangia × 6.
Fig. 3*a*. A group of sporangia, natural size, to show habit.
Fig. 3*b*. A single spore × 1800.

Physarella mirabilis, Pk. (*Tilmadoche oblonga*, B. and C.), p. 157.

Fig. 4. A single sporangium × 8.
Figs. 4*a* and 4*b*. Capillitium and spore respectively × 900.

Craterium leucocephalum, Pers., p. 144.

Fig. 5. Sporangia, the first closed × 10.

Physarum sinuosum, Bull., p. 157.

Fig. 6. Plasmodiocarp, natural size; 6*a*, × 4.

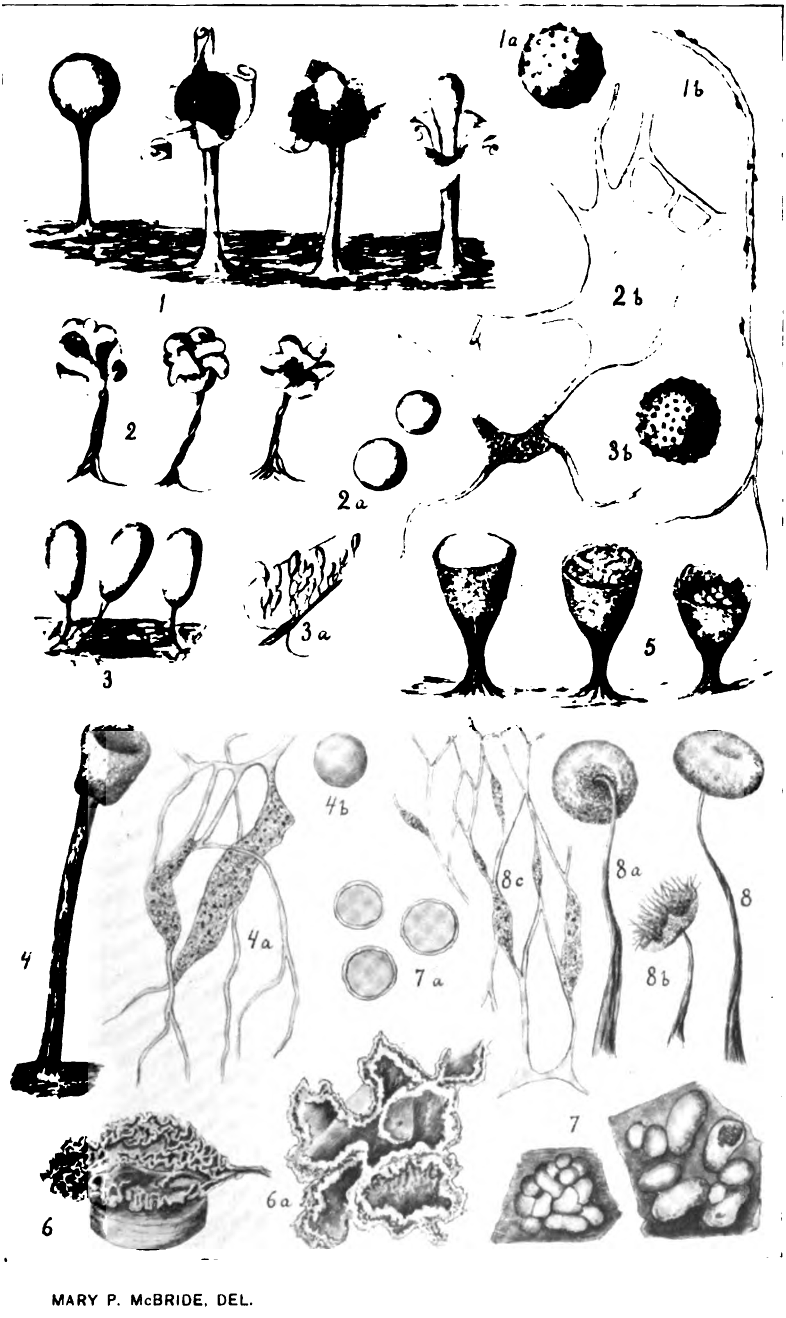
Physarum ditmari, Rost., p. 155

Fig. 7. Groups of sporangia × 3 and by 8.
Fig. 7*a*. Spores × 750.
A drawing illustrative of the capillitium of this species was by accident unfortunately omitted.

Tilmadoche viridis, Gmel., p. 152.

Fig. 8. A single sporangium × 25; 8*a*, reverse.
Fig. 8*b*. The same after spore-dispersal.
Fig. 8*c*. Capillitium × 750.

PLATE VIII.



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EXPLANATION OF PLATE IX.

Physarum didermoides, Ach., p. 154.

Fig. 1. Sporangia × 15.
Fig. 1*a*. A single sporangium open; shows calcareous capillitium × 15.
Fig. 1*b*. Spores × 900.

Physarum leucophæum, Fr., p. 156.

Fig. 2. A cluster of sporangia × 15.
Fig. 2*a*. A single sporangium, open × 15.
Fig. 2*b*. Spores × 900.

Physarum contextum, Pers., p. 157.

Fig. 3. A group of sporangia × 15.
Fig. 3*a*. Spores of the same × 600.

Physarum cinereum, Batsch., p. 155.

Fig. 4. A group of sporangia × 4.
Fig. 4*a*. A single sporangium × 20.
Fig. 4*b*. Capillitium of the same × 240.
Fig. 4*c*. Spores × 450.

Physarum auriscalpium, Cke., p. 158.

Fig. 5. Sporangia × 5.
Fig. 5*a*. Spores of the same species × 450.
Fig. 5*b*. Capillitium of the same × 240.

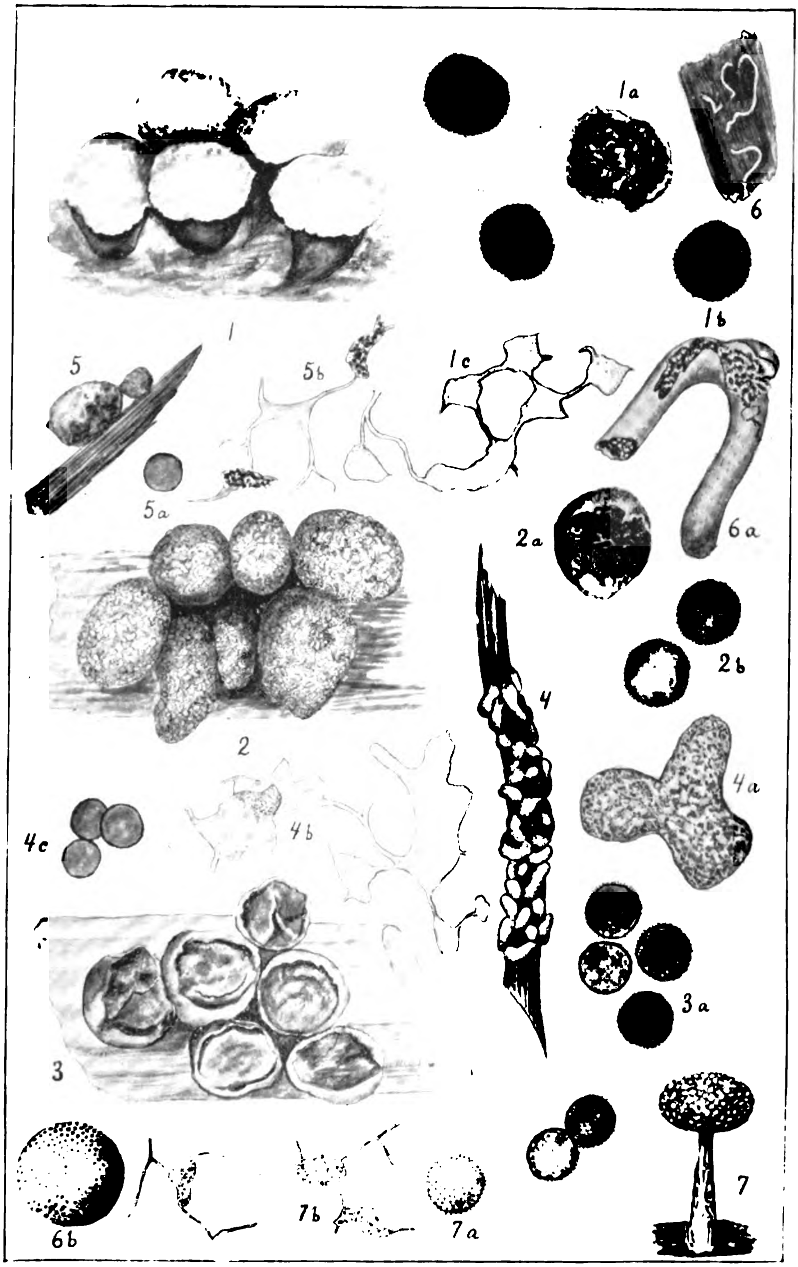
Cienkowskia reticulata, A. and S., p. 150.

Fig. 6. Plasmodiocarps about natural size.
Fig. 6*a*. A bit of the plasmodiocarp showing structure × 6.
Fig. 6*b*. A spore of the same species × 1400.

Physarum leucopus, Link., p. 156.

Fig. 7. A single sporangium × 15.
Fig. 7*a*. A spore of the same species × 900.
Fig. 7*b*. A fragment of the capillitium.

PLATE IX.



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EXPLANATION OF PLATE X.

Badhamia rubiginosa (Ehr.), Cke. p. 159.

Fig. 1. A group of sporangia × 5.
Fig. 1*a*. Two sporangia, same species × 18 to show persisting capillitium.
Fig. 1*b*. Capillitium-fragment × 240.
Fig. 1*c*. Spore of the same species × 750.

Fuligo varians, Somm., p. 160.

Fig. 1. An æthalium, natural size.
Fig. 2*a*. A section of the same × 10.
Fig. 2*b*. A spore of the same × 750.

Physarum ellipsosporum, Rost., p. 158.

Fig. 3. An æthalium borne upon a blade of grass, natural size.
Fig 3*a*. Capillitial fragment from the same specimen × 450.
Fig. 3*b*. Spores of the same × about 750.

Didymium proximum, B., and C. p. 145.

Fig. 4. A single sporangium × 25.
Fig. 4*a*. The capillitium and fragment of the peridium of the same species, × 380.
Fig. 4*b*. A spore of the same species × 1000.

Trichia iowensis, Macb., p. 133.

Fig. 5. Tip of an elater × 1400.
See also Plate V, Fig. 4.

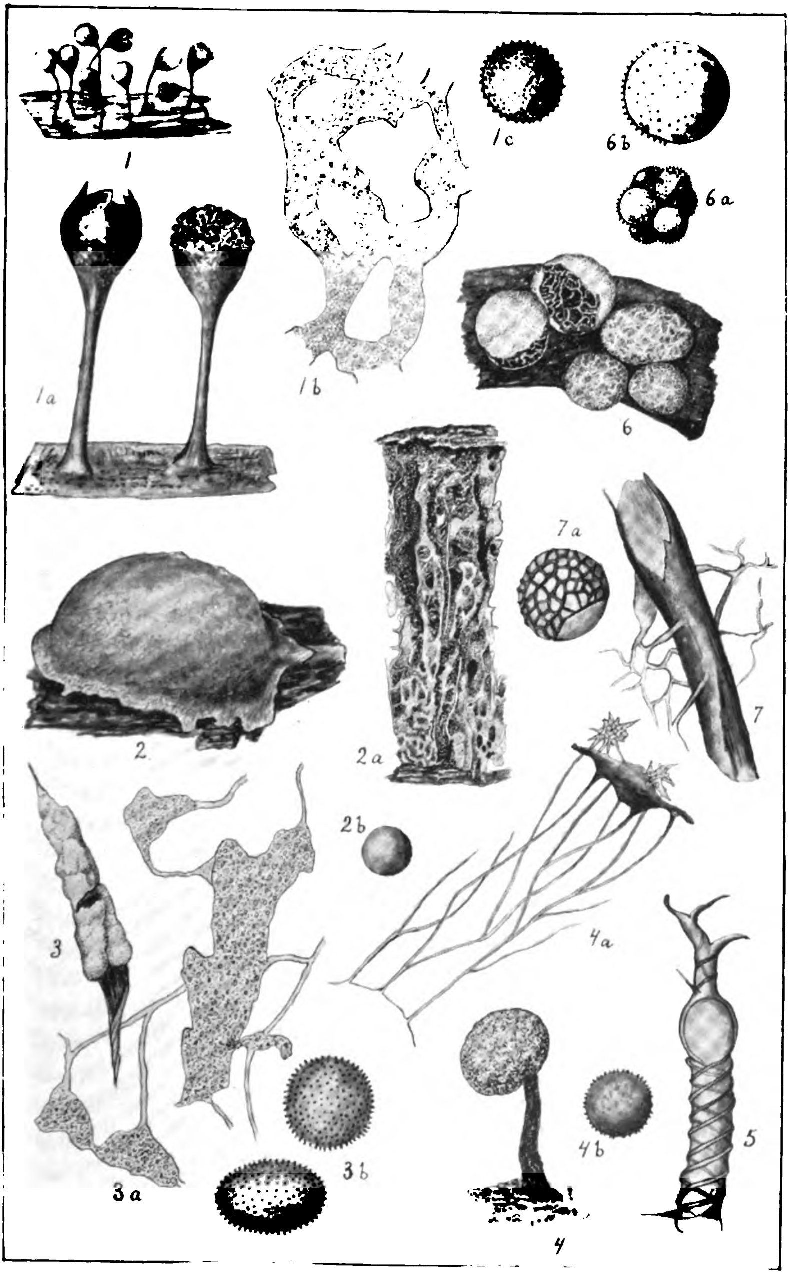
Badhamia papaveracea, B. and R., p. 159.

Fig. 6. Sporangia, a cluster × 8.
Fig. 6*a*. A cluster of spores × 400.
Fig. 6*b*. A single spore of the same × 1400.

Reticularia lycoperdon, Bull., p. 136.

Fig. 7. A fragment of the capillitium × 240.
Fig. 7*a*. A single spore of the same species × 1400.

PLATE X.



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EXPLANATION OF PLATE XI.

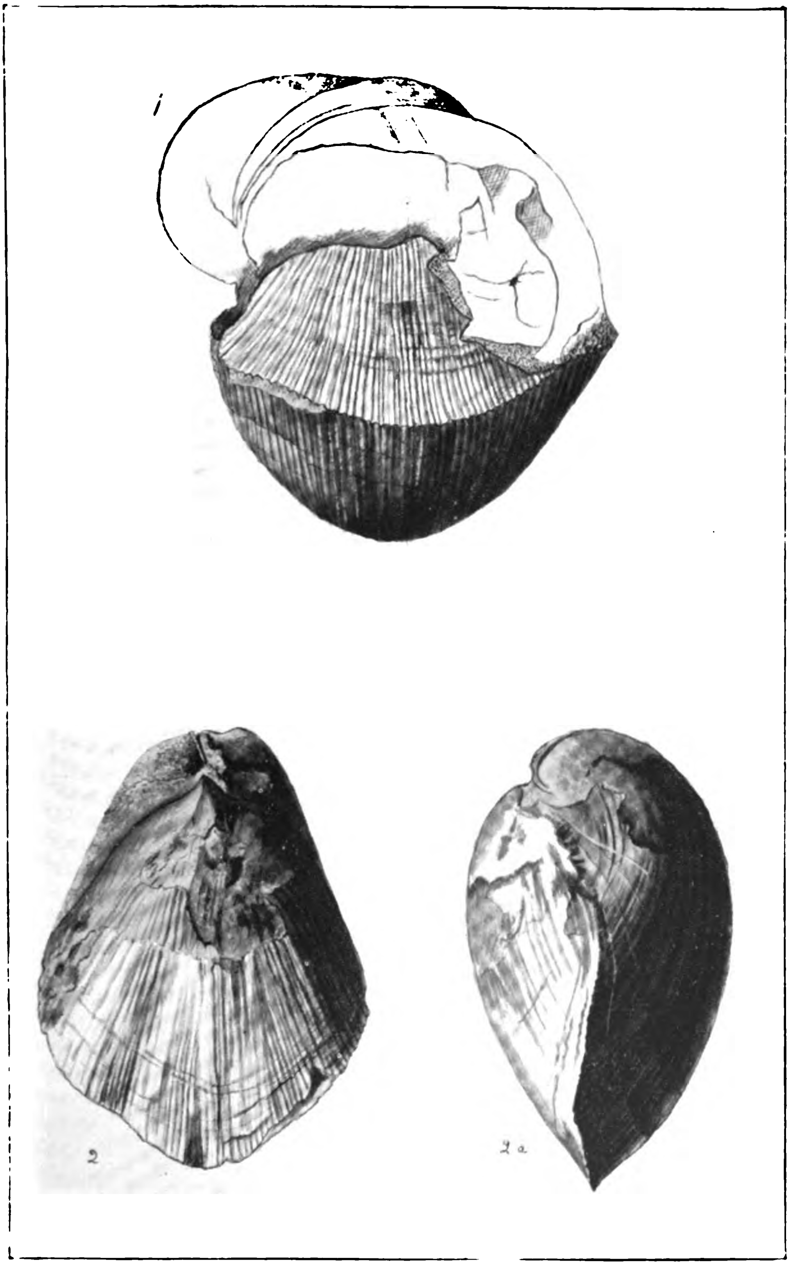
PENTAMERUS DECUSSATUS. PAGE 164.

Fig. 1. Front view of one individual with portion of a second individual attached.

Fig. 2. Dorsal view of a specimen of average size.

Fig. 3. Profile view of individual illustrated in Fig. 2.

PLATE XI.



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EXPLANATION OF PLATE XII.

SPIRIFERA URBANA. PAGE 166.

Fig. 1. Dorsal view of type specimen.
Fig. 2. Profile of same specimen.

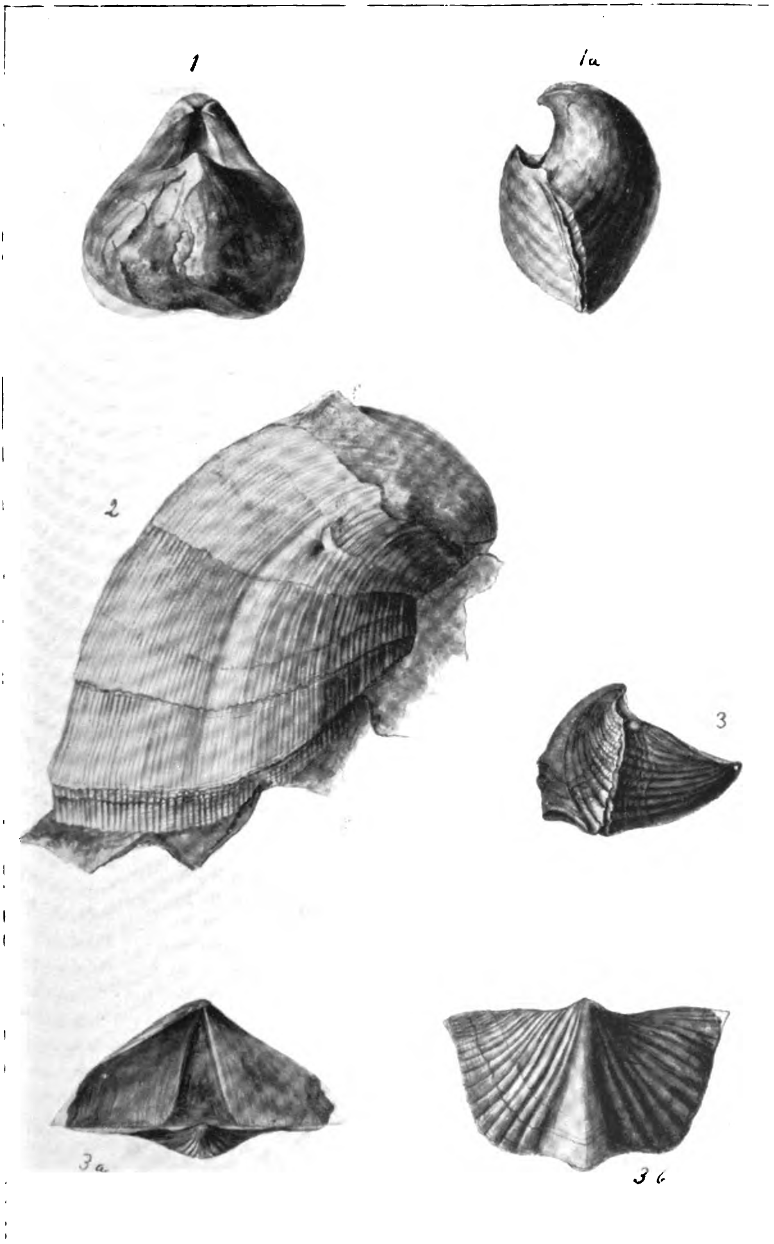
SPIRIFERA MACBRIDEI. PAGE 166.

Fig. 3. Profile of average individual of this species.
Fig. 3*a*. Cardinal view.
Fig 3*b*. Dorsal view.

PENTAMERUS DECUSSATUS. PAGE 164.

Fig. 2. Profile view of ventral valve of an elongate narrow individual.

PLATE XII.



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EXPLANATION OF PLATE XIII.

Fig. 1. Diagram map of Rock River near its mouth. The lower part of the diagram is not correct, as it represents the river as too nearly westerly in its course.

a. and *b.* Points between which sections were made.

c. Point near which the section represented in Fig. 2 was taken.

d. Sand-bar on which the shells are washed up in great numbers.

Fig. 2. Section taken at *c*, Fig. 1.

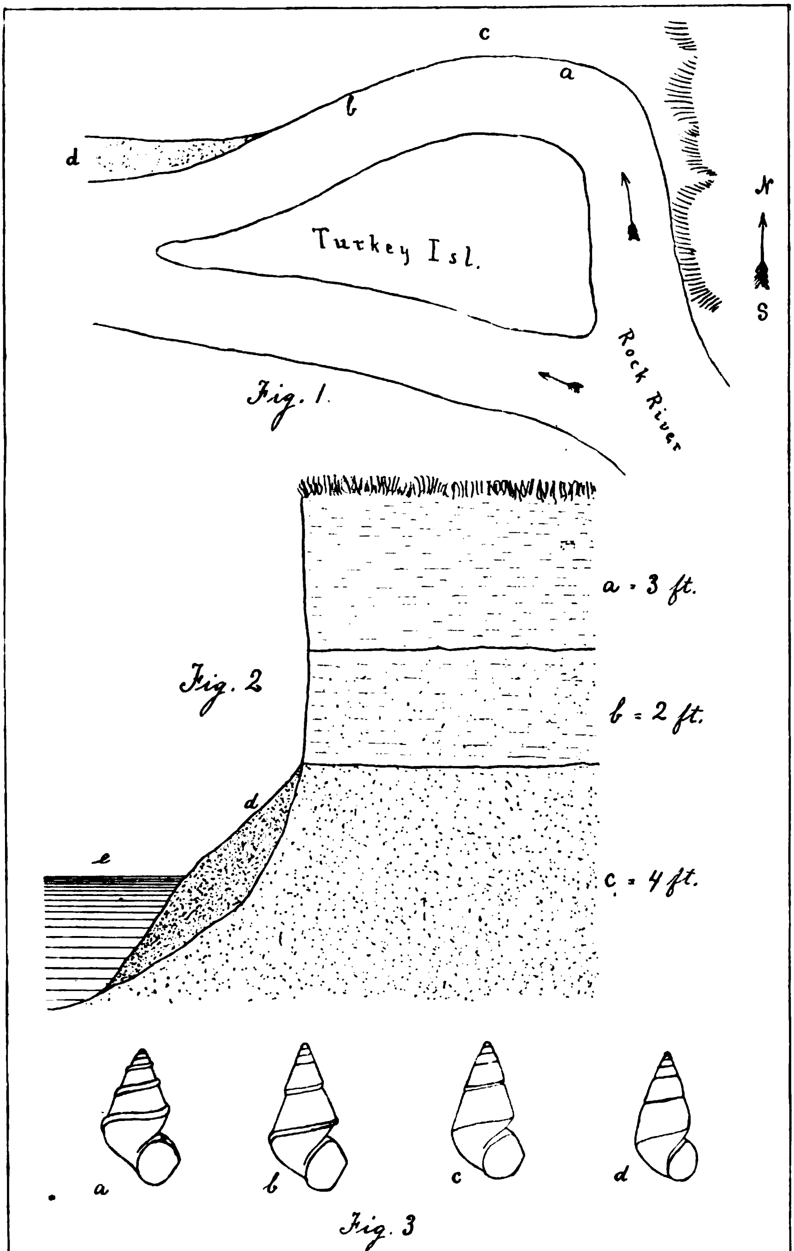
a, *b*, *c*. The three strata; *b* and *c* are stratified and laminated.

d. Deposit of loose sand.

e. Surface of water in Rock River at low water.

Fig. 3. *a*, *b*, *c*, *d*. *Pyrgulopsis scalariformis* (Wolf), Call and Pils. × about 5.

PLATE XIII.



B.S. del.

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The earlier numbers of this and the first volume are no longer to be supplied.

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BULLETIN

FROM THE

LABORATORIES OF NATURAL HISTORY

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IOWA CITY, IOWA:

JANUARY, 1893.

Secretary WM. J. HADDOCK:

We take pleasure in submitting herewith Bulletin No. 3, of Volume II, from the Laboratories of Natural History, State University of Iowa.

THE EDITORS.

ON THE EARLY STAGES OF THREE NORTH AMERICAN COLEOPTERA.

By H. F. WICKHAM.

So little is known regarding the biology of our native beetles that the writer considers no apology necessary in offering the present contribution. The three species belong to as many different families, and two of them to genera of which the metamorphoses have not been made known in our literature—*Epipocus* and *Ellychnia.*

Attempting to avoid that insufficiency of detail so noticeable in many of the earlier descriptions, the writer hopes to be pardoned if he has gone to the other extreme, and trusts that the sketches of dissections and the comparisons with allied forms will not be useless. He also wishes to express his indebtedness for references, to Mr. Wm. Beutenmueller's "Bibliographical Catalogue of the Described Transformations of North American Coleoptera," an invaluable aid to students of the life history of insects of this order.

DICÆLUS SPLENDIDUS, *Say.*

Color of larva dark blue-green, subopaque, space between ends of scutes and the lateral margins of abdominal segments brownish yellow; head reddish yellow; ventral surface more blue than the dorsal, the parts of the integument not covered by scutes, brownish-yellow.

Form rather elongate, fusiform, narrower anteriorly.

Head not deeply inserted in thorax, a little concave above, beneath convex, slightly flattened, somewhat narrowed from the point of the insertion of the antennæ to the base. The

upper surface has a rather vague median groove, the remaining points of sculpture corresponding tolerably well to the description given of a *Dicælus* larva by Dr. Horn in the Trans. Amer. Ento. Soc., VII., p. 37, though the lines are well impressed. The triangular impression on the under surface of the head is well defined and extends quite to the basal margin.

Eyes consist of six ocelli, around a raised dark spot immediately behind the insertion of the antennæ.

Antennæ four-jointed, inserted immediately behind the mandibles, first joint shorter and stouter than the others, glabrous, second more than twice as long, also glabrous except for a few hairs near the tip, third a trifle longer, fourth a little more slender and also longer; the last two joints are pubescent.

Mandibles rather long, arcuate, with a strong tooth at base and with minute serrations internally.

Maxillæ with stout basal piece and two terminal appendages, the outer the larger and having the basal joint as broad as long, bearing stout bristles; second joint more slender, about twice as long as broad, slightly bristled; third joint still more slender and tipped with a tubercle, probably really a fourth joint. Inner piece two-jointed, proportioned as in figure. Just posterior to this is a third appendage, very small, two-jointed (the second joint being very minute), the first joint bearing a stout bristle.

Mentum broader than long, bearing short two-jointed palpi, the joints nearly equal, the second oval.

Prothorax longer than wide, narrowed in front, angulate behind the middle, and with a longitudinal well impressed median line for the entire length, on each side of which is a feeble oblique impression. Except for one or two long bristles near the posterior angles it is naked.

Mesothorax shorter and broader than the prothorax but with about the same sculpture, metathorax still broader.

Abdomen. First segment shorter than the others, second to eighth subequal. The dorsal surface of each bears a scute sim-

ilar to the thoracic pieces but a little narrower, each scute having a distinct median line and a large lateral fovea with raised center, as well as the oblique impressions shown on the thorax. The ninth segment is narrower than the others and bears two long processes which apparently originate on the dorsal surface of the segment near its base. Unfortunately they were accidentally broken off in my specimen and I can judge only from the broken surface as to the exact point of attachment. These processes are seen under a high power to be minutely rugose and are sparsely armed with small points. The lateral margin of each segment of the abdomen is armed with a corneous, tooth-like plate, bearing bristles. In ventral aspect each of the segments from the first to the seventh bears six corneous plates arranged as shown in the figure, the large anterior ones bearing setæ which are directed backwards. On the eighth segment all the plates except the lateral ones are united, on the ninth they are all joined. Anus prolonged, corneous, grooved beneath.

Spiracles nine on each side, the first pair situated under the anterior angles of the mesothorax, the remainder in the dorsal portion of the connecting membranes of segments one to eight of the abdomen.

Legs gradually longer from the first to the third pair, coxæ conical, prominent, femora longer, larger towards the tip and with a well defined oblique impression on the proximal half, tibiæ about half as long, slightly enlarged towards the tip, tarsal piece of the same length as the tibia and bearing two equal claws.

This larva resembles very closely that described by Dr. Horn (Trans. Am. Ent. Soc., VII., p. 37) as either *Dicælus splendidus* or *D. costatus*, but from the fact that the present specimen differs from his description in many details I infer that in all probability the Doctor's insect was of the latter species, the resemblance of the larvæ being no greater than is to be expected in forms so closely allied. Among the main points of difference to which I would call attention are the

following—the stronger sculpture of the head, the apparently stouter maxillæ, the longer second dorsal segment of the abdomen and the difference in the ventral scutes—the two middle plates of the Doctor's specimen coalescing to form one in mine, the line of demarcation being simply impressed. In his figures these plates are divided by a considerable space. The difference in locating the spiracles is due, I think, to a slip of the pen, when, on page 39 of the work cited, the remaining eight spiracles (after mentioning the mesothoracic one) are said to be placed in segments 1–7 instead of 1–8. For the sake of lessening the labor of students who may wish to compare specimens for identification with both, I have modelled my description after that of Dr. Horn, and where his words applied to my insect have not changed them.

The pupa, of which two views are given in the plate, is remarkable chiefly for the great size of the head. The entire length of the pupa is 16 mm., or excepting the protruding hind tarsi, 15 mm. The palpi are very long and the sides of the body, as well as the back, armed with numerous stout bristles. Though nearly white at first, the eyes and jaws soon darken. In fig. 1^b, of the plate, the head is drawn a trifle too small.

Described from one of two specimens found under stones on a damp hillside near Iowa City, August 10th. They were fed in captivity on snails (*Patula alternata*), which they attacked, devouring nearly the whole animal, pushing their bodies into the shell until only the tips of the long caudal processes could be seen. In a few days one of them died, the other pupated August 19th or 20th and the perfect insect appeared ten or eleven days later.

EPIPOCUS CINCTUS, *Lec.*

Color of larva, blackish brown above, yellowish beneath, both on the thorax and abdomen.

Form sub-elongate rather depressed, the younger larvæ proportionately longer than those about to be transformed into

pupæ; the figure shows one somewhat extended, in life they hunch up the back and appear relatively shorter, the head being scarcely visible. Length 9-10 mm.

Head small, concave in front, somewhat narrowed behind, thickly clothed with rather long compound scales of the form afterwards described, each situated in a distinct puncture. The intervening spaces are minutely roughened.

Eyes. After careful search I find only two ocelli situated a little behind the base of the antennæ.

Antennæ inserted rather far back, at the sides of the head, four-jointed, the basal joint large, wide, second joint about as wide as long, third joint more than twice as long as wide and tipped with a small sharp pointed tubercle which constitutes a fourth joint. The third joint also bears, close to the tip, a small bristle-tipped appendage which is drawn a trifle too large in the figure. Excepting a few bristles close to the tip, the antennæ are quite naked.

Mandibles rather stout, arcuate, pointed at tip, armed on the inner or cutting edge with five small teeth, the distal one of which is the largest. The outer portion is prolonged into a long, sharp, fang-like tooth. In the lower inner angle of the mandible is a body of very fine consistence, extremely thin and plate-like, fringed around the edge, it is shown in fig. 2^c.

Maxillæ with the inner part sub-triangular in outline, the tip somewhat deflected outward, and covered with very small, thick bristles, they might almost be called cusps. Palpus three-jointed, the joints increasing in length and decreasing in width from the first to the third. Mentum with short, two-jointed palpi, the basal joint thick, the second more slender and tapering.

Prothorax a little wider than long, angulate behind the middle and bearing on each side of the median line a large scute which is covered with scales or bristles of the form shown in fig. 2^l. The remainder of the surface is nearly naked, presenting the appearance, under high power, of being

minutely roughened. Meso- and metathorax subequal, a little shorter than prothorax, also with impressed median line and scutes, the latter somewhat elliptical in form and depressed at centers; the vestiture is the same as that of the prothorax except that the scales are more numerous over that part of the segment not covered by the scute. Each of the thoracic segments bears a large lateral appendage which is covered with long scales (fig. 2^h).

Abdominal segments 1–8, each with a central raised spot, surrounded by a channel, and two pairs of lateral appendages one dorsal and one ventral. The ninth segment has but one pair. These appendages are clothed, like those of the thorax, with long scales, the rest of the segment, excepting the anterior and posterior margins, with short scales.

Spiracles. The first is situated on the under surface of the mesothorax not far from the anterior angles; the remaining eight pairs being situated near the anterior margin between the lateral appendages of segments 1–8 of the abdomen. Under the high powers of the microscope each spiracle is seen to be surrounded by a ring of smooth, rounded spots which I took, at first, to be additional apertures. The margin of each spiracle is fringed with cilia.

Legs of nearly equal length, all rather short, bristled rather heavily. The coxæ are very long, the full length not being shown in the sketch at fig. 2^j, though the proportion of the other parts are well given.

This is a most remarkable larva, resembling, in many particulars, that of *Aphorista vittata* Fab., described by Prof. J. B. Smith in the second volume of Entomologica Americana, page 85, from which it presents, however, a number of curious divergencies. The vestiture, in the larva of *Epipocus*, consists of the remarkable scales figured, while that of *Aphorista* is composed, according to Prof. Smith, of numerous fanlike clusters of hairs. In each case the scales or clusters arise from distinct punctures.

The pupa is of the shape shown in the figure. The gen-

eral color is a dirty yellowish white with two slightly darker spots on the back at the base of the mesothorax, the series of five spiracles on each side near the base of the lateral processes being shining brown. The processes are annulated by a series of constrictions, and bristly; the wings pass under the anterior and median legs and over the posterior pair, the antennæ overlying the wings and hardly passing under the anterior and median legs. Length 8 to 10 mm.

Larvæ and pupæ were found under logs, in damp places, in company with perfectly fresh specimens of the perfect insect, at Columbus, Texas, a little before the middle of July. The larvæ were of various sizes and are gregarious in habit, emitting a milky fluid when disturbed or handled — they vary somewhat in their proportions, those about to pupate being shorter and broader. The pupæ were attached by the posterior extremity to the bark of the log, the larval skin adhering as shown in the figure.

ELLYCHNIA CALIFORNICA, *Mots.*

Color of alcoholic specimen of pupa dirty yellowish white, tinged with rosy on the middle of the prothorax, meso- and metathorax, and all but the three of the dorsal segments. The ventral segments also show this tinge.

Form rather broad, dorso-ventrally compressed; a fair idea of the general appearance of this insect may be had from the plate, of which fig. 3 represents a front, and 3[a] a side view. The front and side margins of the prothorax are thin and somewhat widely explanate, covering the head; wings tucked under the antennæ and two pairs of legs but passing over the posterior pair. Tarsal joints indistinctly marked. Sides of abdomen doubly serrate, the points diverging.

Described from a specimen found by me under a log at Fort Wrangel, Alaska, in June, 1891. As the pupa is somewhat shrunken from immersion in spirits, a description of the depressions and elevations of the surface is apt to be rather misleading than useful.

REPORT ON AN ENTOMOLOGICAL RECONNOISSANCE OF SOUTHERN ALASKA AND ADJACENT PORTIONS OF BRITISH COLUMBIA.

By H. F. WICKHAM.

In the summer of 1891 the writer made a trip to the North with the intention of making collections of the Coleoptera of such portions of Southern Alaska as might prove accessible with the few weeks of time and limited means at hand, believing that an examination of that region would be productive of much of interest bearing upon Geographical Entomology. Since the Russian explorations, made before the middle of the present century, the results of which are embodied chiefly in the writings of Eschscholtz, Mannerheim and Motschulsky, but little has been added to our knowledge of the insect fauna of our great northern territory. Even these works are accessible to but a small minority of our American Entomolgists, and as a considerable proportion of the species enumerated in the present paper are not mentioned elsewhere as native to the Alaskan fauna it is hoped that this contribution will prove acceptable.

The Coleopterous fauna of the Stikine River, on which several days were spent, was heretofore practically unknown to the world at large, the collections made by members of the Telegraph Survey having been apparently never worked up for publication though many Coleoptera, part of which must have been taken near the river, were distributed to different collections. A list of Lepidoptera taken in the more or less immediate vicinity of the river by Dr. G. M. Dawson and his assistant Mr. J. McEvoy is published by Mr. James

Fletcher in the Report of the Geological and Natural History Survey of Canada for 1887–88.[1] If any Coleoptera were taken they are not included in the enumeration of insects.

To students wishing to see material from the region treated of, the following list of cabinets wherein more or less complete sets of them have been placed by the writer may be of interest. First in importance is the series contained in the National Museum, complete or nearly so, in all orders but the Coleoptera; that of Dr. Geo. H. Horn in Philadephia for Coleoptera; several of the larger New York collections and the Museum of the Geological and Natural History Survey of Canada also contain considerable series in this order, while a set, complete except about half a dozen species, has been retained in the cabinet of the writer, now deposited in the Museum of the State University of Iowa.

To many friends, the writer is under obligation for aid in correctly identifying the material brought back and for valuable notes on distribution. Dr. Horn has kindly gone over a very large part of the collection and Capt. Thos. L. Casey has named the material in some groups of Staphylinidæ to which he has given special attention. To Dr. John Hamilton, thanks are due both for determinations and notes, while Messrs. Leng and Brendel have helped on the Cerambycidæ and Pselaphidæ. For an examination of the Aleocharini and some other Staphylinidæ I am indebted to the distinguished European writer, M. A. Fauvel, of Caen, France. Dr. Selwyn has very kindly sent me the Reports of the Survey of which he is Director and they have proved valuable in the preparation of this paper.

[1] Annual Report (New Series), Vol. III., 1887–88. The Report B, "On an Exploration in the Yukon District, N. W. T., and an adjacent northern portion of British Columbia," by Dr. G. M. Dawson, contains a good map of the Stikine River and has been consulted and followed in giving geographical data.

Leaving Tacoma on the 17th of June, by the steamer "Mexico" the first stopping place in Alaska was reached on the 21st—the cannery at Yes Bay. Here, while the freight was being discharged, I went ashore hoping to find some good insects, but discovered that work in the Alaska forests was going to be a different thing from that in the States. The land is rugged and hilly, the ground damp and covered with a rank growth of moss while the heavy growth of conifers and dense underbrush made it almost an impossibility to penetrate far from the beach. Any branches or other pieces of wood that may fall or be left lying on the ground are soon so firmly bound down by the network of roots which penetrate or moss that binds as to be nearly immovable, and any insect resting beneath is safe from pursuit. All that could be found were a few *Pterostichus castaneus*, some Staphylinidæ, twenty or thirty little moths and a fly or two. The moths were flying about the flowers of the "devil's club" (*Fatsia horrida*) a rank, heavy plant, covered with prickles, scratches from which sometimes cause considerable irritation; it is said to be used by the natives in the treatment of venereal diseases. The stop here was a short one and soon afterwards the steamer touched at Loring where I got two or three species of Scolytidæ flying around newly cut timber.

The next morning we reached Fort Wrangel which lies at the upper end of Wrangel Island, almost directly opposite the mouth of the Stikine River, in latitude about 56° 28′ N. The village lies along a long narrow strip of beach while back of it rise hills of considerable height covered with a growth of conifers and the usual underbrush. Close to the beach are dense thickets of salmon-berry and thimble-berry the fruits of which are used for food though of rather poor flavor compared with berries of more southern climates. These thickets are plentifully interspersed with high nettles which make collecting a rather arduous task.

At Fort Wrangel a cabin was secured and preparations made for a stay of some length as this place was to be my

headquarters from which I hoped to make excursions to the surrounding country. Investigation showed that the Coleopterous fauna of the island presented nothing very remarkable, compared with other points in the North Pacific and was by no means varied. The Carabidæ, Staphylinidæ, Elateridæ and Lampyridæ were the families best represented, not, however, because of an unusual development of these families, but because of a fading out of others more characteristic of warmer climes.[1] A list of the species taken is appended to this report so that a few more general notes are all that need be chronicled here.

Along the beach, the debris cast up by the sea yields something, but not very much, an occasional example of *Aleochara sulcicollis* Mann, with here and there an *Homalota* being about all. A little higher up, out of the reach of the high tide, *Cryptohypnus musculus* Esch. was taken rather commonly, resting under "shingle," seldom under drift-wood. This species does not occur in colonies of any size, usually only from one to four specimens being sheltered by the same piece. The pieces of drift cast high up afford protection to *Cychrus marginatus* and a few Trichopterygidæ while the very few Pselaphidæ taken occurred mostly in the same places.

Just outside of the village was a spot where a considerable space, clear of bushes, was rendered almost a marsh by water running over it from the adjacent hills. Many little blocks and logs of wood were resting on the soft ground, half overgrown with grass, and this proved the best place for Carabidæ that I found on the island. The following species occurred in no other kind of situation: *Pterostichus vitreus* Dej., *P. riparius* Dej., *Loricera 10-punctata* Esch., *Bembidium flavopictum* Mots., *Bembidium cautum* Lec., *Patrobus septentrionis* Dej., and *Platynus erasus* Lec. Nearly all the water beetles I got came from this little spot, searching the streams with water nets yielding nothing.

[1] See Dr. Leconte's paper—"Report upon Insects collected on the Survey," page 2. (U. S. P. R. R. Exp. and Surveys.)

Along the outskirts of the forest, flying slowly around, may be seen *Athous ferruginosus* Esch., the most plentiful Elaterid in this part of Alaska; any disturbance of the vegetation or even the sound of footsteps seemed to start them up and they flew aimlessly around, often alighting on my clothes or hands and easily captured. When a log, deeply imbedded in moss and grass, was turned over, these insects would come out from resting places on or near the ground, running up the stems of plants until a favorable place for starting was reached, when they took wing. Occasionally a *Corymbites tarsalis* Melsh., or a *C. caricinus* Germ., might be seen with the *Athous* and *Podabrus piniphilus* Esch., frequents the same situations. In the deep forest but little could be found, the first half day's work yielding only six specimens, all of *Pterostichus castaneus* Dej.; these occurred under pieces of wood in a path. Careful search among the deep moss proved fruitless.

The most productive plan of collecting proved to be setting baits for carrion beetles, and with the object in view of collecting such insects I piled up, in a little patch of brush a few yards from my cabin door, all the bodies of birds whose skins had been utilized for museum purposes. Every day this heap of bodies was looked over carefully and all the loose soil beneath taken up and sifted. In this way I managed to get many good things, numbers of Staphylinidæ, some *Choleva egena* Horn., *Cercyon fulvipenne* Mann., *C. adumbratum* Mann., *Ptilium columbianum* Matth., and occasionally other Trichopterygidæ. The Longicorns and Chrysomelidæ evidently did not thrive on the island; two specimens of *Opsimus quadrilineatus* Mann., and a single *Phymatodes* constituted the entire representation in the former family while the latter did not appear at all. Beating trees was tried but the only result proved to be *Magdalis ænescens Lec.*, and this very rare.

Little can be said here regarding the other orders of insects, a list of which will very probably be published later by the authorities of the United States National Museum. Lepidoptera were not common, neither were Hymenoptera though

one species of Humble-bee was seen in some numbers around a little patch of white clover. Diptera were numerous in individuals but apparently not in species, the Orthoptera were not represented at all. A fine Dragon-fly was not particularly rare but I got no specimens of it.

On the 27th of June I left with two men and a canoe for the mainland, intending to run into a bay about twenty-five miles distant, send the men up the mountain after goats while I collected insects. Two days' hard and steady work brought us to our destination where we camped in an old deserted cabin, glad enough of any shelter after forty-eight hours spent almost entirely in the rain. Not feeling equal to the work of ascending the mountains next morning, as I was stiff and sore from the previous exposure, I sent the men across the bay after the goat while I made preparations to collect where I was. Rain soon stopped me though, with little to show but a *Liparocephalus brevipennis* Mäkl., a nice Staphylinid found under seaweed. The morrow was clear and some very interesting additions were made—*Syneta simplex* Lec., *Leptalia macilenta* Mann., *Pachyta monticola* Rand., *Corymbites caricinus* Germ., *C. tarsalis* Melsh., and *Anaspis rufa* Say., on flowers. A number of flies and bees, with a few Lepidoptera, completed the day's catch and in the evening my men came back without the goat. They had shot one high up on the mountain but as the pelage was in poor condition and the labor of bringing down the specimen so great, they abandoned it. One of them brought me a specimen of *Donacia femoralis* Kirby, taken from a snow bank at a high altitude, and one each of *Eros simplicipes* Mann., and *Rhyncholus brunneus* Mann. We started back early next day, and with a favorable wind for part of the distance reached Fort Wrangel about midnight.

Sunday morning, the 12th of July, I took passage on the steamboat "Alaskan" for Telegraph Creek, the head of navigation on the Stikine River. This boat was a small vessel of about seventy tons burden and of very light draught, well

calculated to stem the current of a swift river like the one we were to ascend. Trips are made occasionally for the purpose of carrying provisions to supply the miners between Telegraph Creek and the Yukon.

The Stikine is a large river flowing into the Pacific a little north of Fort Wrangel; for a distance of about twenty miles from the sea the general trend of the valley is east and west, then the river bends in a quadrant of arc and assumes a nearly due north direction which it maintains for about sixty-six miles. Beyond this, the valley is continued in a nearly direct northeasterly course to the vicinity of Dease Lake, but the upper portion is occupied by the Tanzilla, the main river entering this continuous valley from the southward.[1] The stream is subject to annual freshets which make navigation at times rather dangerous. It was just at the time when the high water was supposed to be subsiding that I left Wrangel for the upper river.

All went well for two days; we ran up, with an occasional stop for wood, passed magnificent mountains and numerous glaciers, some close to the river, others distant, reaching the lower end of the Little Canon on the evening of the second day. The water had been steadily rising again and it was not without misgivings, that on the morning of the 14th, the captain decided to make the attempt to run through this gorge—dangerous at such a stage of water. A line was taken ashore and both the wheel and capstan made to do duty in propelling the boat up stream. Two-thirds of the way through the canon an eddy swung the boat against a rock and a very short time sufficed to sink her. Before she went down, however, the captain had run her out of the lower end of the canon, and the vessel sank, close to the bank, in almost the exact spot where we had tied up the night before.

This place was my camp for several days and collecting was resumed immediately. I was situated in a grove of willows and cottonwoods, with heavy undergrowth, and the high

[1] Dr. G. M. Dawson, loc. cit., p. 47 B.

water seemed to have driven the insects pretty well together. Wherever a lot of leaves had drifted into a hollow there were plenty of Carabidæ and a few beetles of other families. These are enumerated farther on. The tents of the party seemed to be quite attractive to insects, probably on account of the large expanse of light colored surface exposed, and in the mornings I often took a number of species at rest in such places. These were mostly small species, Staphylinidæ, Cryptophagidæ and the like, part of them such as are found around houses and it may be that some of them were attracted by the smell of food. The high hill close to the camp did not support the same fauna as the river bottom—but little was taken upon it besides a few *Cryptohypnus nocturnus*, which occurred under logs resting on nearly dry moss.

Here I stayed for five days, collecting while it was light and retiring at night to my tent, made of a large quilt stretched over three willow arches. It was impossible to sleep except under shelter on account of the swarms of mosquitoes, which also made the work of collecting far from pleasant. A little farther up the river some of the few white residents wear hats with a bag-like gauze veil attached, after the fashion of those used by bee-keepers; I tried wearing mosquito netting over my face, but could not see through it well enough to collect small insects and so had to go without other protection than that afforded by smearing the face with a mixture of oil of pennyroyal and alcohol. This will keep them off for a time, but a fresh application has to be made every few minutes.

Early on the morning of Sunday, the 19th of July, I started on up the river with a canoe-load of Indians who had been camping near us for two or three days. They pulled their large canoe (which would hold twenty men and was hollowed out from a single tree trunk) through the canon by means of a line, two them remaining in it to keep it off the rocks. Meanwhile, after seeing them fairly started, I made my way across the hill to the upper end of the canon through

one of the roughest and meanest pieces of woods it has ever been my misfortune to see. Though the distance could not have been more than two miles it took nearly as many hours to walk through the brush before I struck the "blazed" trail that I knew led to the place of meeting.

The Indians were there ahead of me and the trip up to Glenora took very nearly two days of hard work, much of it in the way of "poling" the canoe or by dragging it forward with long hooked poles made by the natives to catch hold of bushes or branches and so aid in the progress of their craft by pulling. Running so close to the banks, which were overgrown with brush, we could use only half of our large sail except in making crossings where we often lost in a few minutes what had taken much hard work to gain. It was a wild ride, many a time the water was so rough that we shipped a good lot of it, and but for the perfect familiarity of the Indians with the river we could have made no headway at all.

About five o'clock on the afternoon of the 21st we reached Glenora, where, by the courtesy of Mr. George Pritchett, the customs officer, I was installed in the old customs house which has not been used as such since the time of the mining activity several years ago. The village itself is almost deserted, except for a few Indians—of whose morals the less said the better. Just above Glenora and for some distance up the river is a famous berrying ground, and the Tahl-tan Indians gather the berries for winter use, preparing many also to be disposed of to the Coast Indians at Wrangel. Back of the village, which is built on a flat close to the river, rise terraces, and in the distance ranges of mountains are to be seen. The climate is very different from that of Wrangel, being much warmer in summer and colder in winter, the rainfall also much less. The forest is not so dense, the trees smaller and the underbrush not thick enough to oppose any great obstacle to a man on foot. Berries of many kinds grow in great profusion and of good flavor, contrasting with the insipid, water-soaked fruits of the coast.

The Coleopterous fauna shows now more of an inland character, reminding me closely of the Cœur d' Alene district of Idaho, not so much on the account of the identity of the species as the general facies. Along the bank of the river, a few species of *Nebria* occur in more or less abundance beneath debris, in company with *Patrobus aterrimus* Dej., and *Platynus piceolus* Lec. A few *Bembidia* may be found near the water, and refuse matter on the sandy beach furnished a number of *Aleocharæ* and *Homalotæ*. From under the bark of a stranded log I took a number of *Dryocætes affaber* Mann., *Polygraphus rufipennis* Kirby, and *Omalium pusillum* Grav. The hill fauna was entirely different, the proportion of Carabidæ being much smaller; here were found *Cytilus trivittatus* Melsh., under burnt logs in company with *Bembidium morulum* Lec., and an occasional *Cryptohypnus nocturnus* Esch. In fungi a number of things were taken, *Aleochara mœrens* Er., *Oxypoda* sp., *Gyrophæna bihamata* Thoms., *Tetratoma concolor* Lec., and *Hallomenus punctulatus* Lec. I was much surprised to find a specimen of *Platycerus depressus* Lec., in this high latitude (about 57° 50′ north) and so far inland as to be comparatively little subject to the modifying influence of the warm current which bathes the coast of Southern Alaska. The altitude of Glenora must be near five hundred feet above the sea level, and in the far North a slight difference in elevation has its effect on the temperature.

Unfortunately the bad food on which I had been living for several days (all my provisions having been submerged in the sinking of the steamer and thus rendered hardly fit for use) had the effect of weakening me so much that I thought it best, after two or three day's work here, to accept the offer of some prospectors, who were returning to the coast after a trip in the Cassiar District, to descend the river with them. With favoring wind and current we made the run to the mouth of the river without further difficulty than a broadside collision with a tree that had been washed across a channel usually open.

The few days left before taking passage back to the States were productive of nothing new, insects being much scarcer than they were a couple of weeks earlier; and on the last day of July I left again for Tacoma. A stop for freight at the Indian village of Metlakahtla or Port Chester gave an opportunity for a little collecting, duly improved; the results being a number of *Pterostichus validus* Dej., and *Pt. amethystinus* Dej., found under logs, a *Batrisus zephyrinus* Casey, *Megapenthes stigmosus* Lec., and *Anaspis rufa* Say, the last two on flowers. A few examples of *Tachinus debilis* Horn, and *Quedius capucinus* Grav., were taken under rubbish near the beach. A few hours spent at Hunter's Bay brought to light species of much interest, some of which had not occurred before on the trip. Among them were the rare *Scydmænus biformis* Mäkl., *Pedilophorus acuminatus* Mann., and *Tachinus crotchii* Horn. From a cedar log a number of *Xyloterus bivittatus* Kirby, and a very few *Omalium læsicolle* Mäkl., were taken, just under the bark. This was the last stop made in Alaska, and Tacoma was reached again on the 8th of August.

The following list of insects includes all the species of Coleoptera taken by me in Southern Alaska and the Stikine River Valley of British Columbia. Great pains have been taken to insure correctness of identification and all specimens in any way doubtful have been submitted for examination to some of the best specialists of this country and Europe, whose names will be found on a preceding page. Each locality has been taken up separately, and it will be seen that this mode of recording captures has not entailed a great deal of repetition. Some comparisons of this list with others are give at the close of the Report.

FORT WRANGEL, ALASKA.

CARABIDÆ.

CYCHRUS ANGUSTICOLLIS *Fisch.* In the heavy woods, some distance back from the beach, in rotten logs. Occurred at only one point on the Island.

CYCHRUS MARGINATUS *Fisch.* More common along the beach, just above high water mark, under logs and stones.

LORICERA 10-PUNCTATA *Esch.* Rare; two specimens from a swampy spot near the beach.

NEBRIA MANNERHEIMII *Fisch.* One specimen with *C. marginatus.*

BEMBIDIUM FUNEREUM *Lec.*

BEMBIDIUM FLAVOPICTUM *Mots.*

BEMBIDIUM CAUTUM *Lec.* Found in company with the two preceding species in wet places along the beach, where fresh water has come down from the hills.

PATROBUS SEPTENTRIONIS *Dej.* Under logs, in wet places, chiefly just back of the beach.

TRECHUS OVIPENNIS *Mots.* Two specimens on the beach.

PTEROSTICHUS CRENICOLLIS *Lec.* Rare under logs near the beach.

PTEROSTICHUS CASTANEUS *Dej.* Only in the heavy woods, especially along paths, under pieces of wood.

PTEROSTICHUS VITREUS *Dej.* Near the beach, in wet spots, in company with the next.

PTEROSTICHUS RIPARIUS *Dej.* Rare.

AMARA LITTORALIS *Mann.* Along the beach, not common.

PLATYNUS ERASUS *Lec.* In wet grassy places, under sticks.

HARPALUS INNOCUUS *Lec.* One specimen without record of habitat.

DYTISCIDÆ.

HYDROPORUS OBLITUS *Lec.* Found only under stones or logs, in very wet places. Not common.

AGABUS DISSIMILIS *Sahlb.* Inhabits with the preceding.

HYDROPHILIDÆ.

HELOPHORUS ANGUSTULUS *Mann.* One specimen without record.

CERCYON FULVIPENNE *Mann.* Rather common in decaying flesh and in filth, with the next species.

CERCYON ADUMBRATUM *Mann.* Not common.

CERCYON LUGUBRIS *Payk.* One specimen.

SILPHIDÆ.

PELATES LATUS *Mann.* One specimen.

CHOLEVA EGENA *Horn.* Rather rare, except in one spot where I took a number on and under a mass of decaying flesh.

ANISOTOMA LATERITIA *Mann.* One specimen, found with the preceding, is rather doubtfully referred to this species.

PSELAPHIDÆ.

TYCHUS PUBERULUS *Lec.* One example near the beach.

BRYAXIS ALBIONICA *Mots.* On the beach, under logs. The reference to this species is not very certain, the specimens differing somewhat in color from the types.

FARONUS PARVICEPS *Mækl.* Rare, occurs with the preceding.

STAPHYLINIDÆ.

ATHETA CAPTATA *Fauvel* (*in litt.*). On and under decaying flesh, with the following species of the genus.

ATHETA INGRATA *Fauvel* (*in litt.*).

ATHETA ALASKANA *Fauvel* (*in litt.*).

ATHETA OPACIPENNIS *Mann.*

ATHETA QUADRILLUM *Fauvel* (*in litt.*).

HOMALOTA PLANARIS *Mækl.*

ALEOCHARA SULCICOLLIS *Mann.* On the beach, under sea-weed.

ALEOCHARA CALIFORNICA *Fauvel* (*in litt.*). No record of the manner of occurrence was made.

MYRMECOPORA PHYTOSINA *Fauvel* (*in litt.*). Found along the beach. Rare.

BOLITOCHARA *sp?* Several specimens were obtained by sifting over earth from beneath decaying flesh.

QUEDIUS LIMBIFER *Horn.* A few examples, seemingly a variety of this species were found.

QUEDIUS LÆVIGATUS *Gyll.* Rare.

CREOPHILUS VILLOSUS *Grav.* In rotting flesh. Rare.

PHILONTHUS ÆNEUS *Rossi.* Taken in filth and decaying flesh. Not by any means common.

PHILONTHUS SIEGWALDI *Mann.* In excrement. Not rare.

PHILONTHUS MICROPHTHALMUS *Horn.* A female specimen rather doubtfully referred to this species was taken here.

BAPTOLINUS MACROCEPHALUS *Nordm.* Under bark of conifers.

STENUS ADSPECTOR *Mækl.* Under logs along the beach, close to the edge of the woods. With it occurred the following mentioned species and two unnamed ones.

STENUS JUNO *Fabr.* One female.

STENUS PTEROBRACHYS *G. & H.* Rare, two specimens only.

STENUS MARITIMUS *Mots.* One example.

STENUS *sp.* One near *venustus* Casey and two indeterminata are contained in the collection.

TACHINUS NIGRICORNIS *Mann.* Common around decaying flesh and other dead matter.

BOLETOBIUS DIMIDIATUS *Er.* One specimen, the determination of which is a little doubtful.

OXYTELUS FUSCIPENNIS *Mann.* In filth, not rare, occurs also in decaying flesh.

LATHRIMÆUM FIMETARIUM *Mækl.* Three or four specimens, without special record.

OMALIUM FORAMINOSUM *Mækl.* Rare, found in rubbish under decaying flesh.

PROTINUS *sp.* Two or three examples without record.

MEGARTHRUS ATRATUS *Mækl.* Two specimens were taken in rubbish.

SIAGONIUM PUNCTATUM *Lec.* One specimen in old wood. This species has a very wide distribution as follows:

Pennsylvania, North Carolina, New Mexico (Collection Hamilton), Arizona and Alaska (Wickham). In all these cases it has occurred in mountainous districts.

TRICHOPTERYGIDÆ.

PTILIUM COLUMBIANUM *Matth.* Common in rubbish taken from the ground under carrion.

PTILIUM COLLANI *Mækl.* With the preceding.

PTENIDIUM PULLUM *Mækl.* In rubbish and on chips or logs along the beach.

TRICHOPTERYX PARALLELOPIPEDA *Matth.* Not common, found more especially on the under surface of logs near the beach.

TRICHOPTERYX *sp.* Under logs.

COCCINELLIDÆ.

COCCINELLA NOVEMNOTATA *Herbst.* Three or four examples were taken on herbage.

CUCUJIDÆ.

CUCUJUS CLAVIPES *var.* PUNICEUS *Mann.* One specimen given me by Mrs. Millmore.

LATHRIDIIDÆ.

LATHRIDIUS PROTENSICOLLIS *Mann.* A number of specimens were taken on the walls of my cabin, nearly all gathered in a spot back of an old mirror.

CORTICARIA *sp.* One specimen.

ELATERIDÆ.

EPIPHANUS CORNUTUS *Esch.* Running on wood. One specimen.

CRYPTOHYPNUS MUSCULUS *Esch.* Common on the beach, under "shingle," seldom under drift wood.

ELATER NIGRINUS *Payk.* One specimen from herbage.

ATHOUS FERRUGINOSUS *Esch.* Common on herbage and frequently seen flying, especially when logs were moved.

CORYMBITES LOBATUS *Esch.* Rare, with the *Athous.*

CORYMBITES TARSALIS *Melsh.* Rare, found with the preceding.

CORYMBITES CARICINUS *Germ.* Also quite rare in the same situations.

LAMPYRIDÆ.

EROS HAMATUS *Mann.* One specimen, at rest in the forest.

EROS AURORA *Herbst.* A single example, also taken in the forest.

ELLYCHNIA CALIFORNICA *Mots.* Rare on herbage along the edge of the woods.

PODABRUS PINIPHILUS *Esch.* On herbage, or flying, both in the woods and along the edge. Rather common.

SCARABÆIDÆ.

APHODIUS ALEUTUS *Esch.* Rare, found in dung.

AEGIALIA CYLINDRICA *Esch.* Found rarely along the beach.

CERAMBICYCIDÆ.

OPSIMUS QUADRILINEATUS *Mann.* Rare. One specimen was

taken on the piling of the wharf, another on a fence picket, in the evening.

PHYMATODES ÆNEUS *Lec.* A specimen which may belong here was found dead upon a window.

TENEBRIONIDÆ.

TRIBOLIUM FERRUGINEUM *Fabr.* One specimen.

PHELLOPSIS OBCORDATA *var.* PORCATA *Lec.* Occurred once on old wood.

MELANDRYIDÆ.

MICROSCAPHA (?) ARCTICA *Horn* (*in litt.*). Two specimens of an insect closely allied to *Microscapha* were taken under a piece of bark resting on moss in the deep woods. Owing to the activity of the insect (which resembles *Orchesia* in its movements), a third specimen escaped.

CURCULIONIDÆ.

PLINTHUS CARINATUS *Boh.* One specimen from a sapling.

HYLOBIUS CONFUSUS *Kirby.* A single example was found crawling on the door of my cabin.

ERYCUS MORIO *Mann.* One specimen from the beach.

TRACHODES PTINOIDES *Germ.* One example near the beach.

MAGDALIS ÆNESCENS *Lec.* Very rare. Two or three specimens were beaten from a small tree, called there the "wild crab."

MAINLAND NEAR WRANGEL ISLAND.

CARABIDÆ.

PTEROSTICHUS VITREUS *Dej.* Two or three specimens near the beach.

HYDROPHILIDÆ.

CERCYON FULVIPENNE *Mann.* One or two specimens in dung.

STAPHYLINIDÆ.

LIPAROCEPHALUS BREVIPENNIS *Mækl.* On the beach, under sea-weeds, very rare.

OXYTELUS FUSCIPENNIS *Mann.* Rare, in dung.

ANTHOBIUM POTHOS *Mann.* Common on flowers.

ELATERIDÆ.

ATHOUS FERRUGINOSUS *Esch.*

CORYMBITES LOBATUS *Esch.*

CORYMBITES CARICINUS *Germ.* All three species of Elateridæ were found on flowers, none of them commonly however.

LAMPYRIDÆ.

EROS SIMPLICIPES *Mann.* A specimen was brought by my men from the high mountains, among the snow-banks.

PODABRUS PINIPHILUS *Esch.* On herbage, taken by sweeping, not common.

CERAMBYCIDÆ.

LEPTALIA MACILENTA *Mann.* Very rare on flowers with the variety *frankenhœuseri.*

PACHYTA MONTICOLA *Rand.* One specimen on flowers.

CHRYSOMELIDÆ.

SYNETA SIMPLEX *Lec.* Quite rare, on flowers of a large bush.

DONACIA FEMORALIS *Kirby.* From snow bank on the high mountains.

MORDELLIDÆ.

ANASPIS RUFA *Say.* Common on flowers.

CALANDRIDÆ.

RHYNCHOLUS BRUNNEUS *Mann.* From the high mountains, under bark.

YES BAY, ALASKA.

CARABIDÆ.

PTEROSTICHUS AMETHYSTINUS *Dej.* Under logs in the forest.

PTEROSTICHUS CASTANEUS *Dej.* With the preceding.

STAPHYLINIDÆ.

QUEDIUS FULGIDUS *Fabr.* One specimen, under a board.

STENUS ADSPECTOR *Mækl.* One example.

ANTHOBIUM POTHOS *Mann.* Two or three specimens on flowers of the "Devil's Club."

LAMPYRIDÆ.

ELLYCHNIA CALIFORNICA *Mots.* One specimen on herbage.

LORING, ALASKA.

CARABIDÆ.

PTEROSTICHUS CASTANEUS *Dej.* One specimen.

ELATERIDÆ.

ATHOUS FERRUGINOSUS *Esch.* One specimen, flying.

BUPRESTIDÆ.

MELANOPHILA ATROPURPUREA *Say.* An individual of this species was captured on the side of the cannery.

SCOLYTIDÆ.

XYLOTERUS BIVITTATUS *Kirby.* One specimen was taken on the side of the cannery, in company with the two following.

HYLASTES CAVERNOSUS *Zimm.* One specimen.

HYLURGOPS RUGIPENNIS *Mann.* Two specimens.

HUNTER'S BAY, ALASKA.

CARABIDÆ.

CYCHRUS ANGUSTICOLLIS *Fisch.* One specimen, under loose bark and moss at foot of tree.

NOTIOPHILUS SYLVATICUS *Esch.* One specimen, under rubbish.

PTEROSTICHUS AMETHYSTINUS *Dej.* Under slabs of wood, not common.

PTEROSTICHUS CASTANEUS *Dej.* Rare, with the preceding.

SCYDMÆNIDÆ.

SCYDMÆNUS BIFORMIS *Mækl.* Very rare, found under chips in the deep forest.

STAPHYLINIDÆ.

BAPTOLINUS MACROCEPHALUS *Nord.* Under bark of conifers.

TACHINUS CROTCHII *Horn.* Two specimens, under filth.

OXYTELUS FUSCIPENNIS *Mann.* Rare, in filth.

OMALIUM PUSILLUM *Grav.* (*læsicolle* Mäkl.). Two specimens under bark.

NITIDULIDÆ.

EPURÆA TRUNCATELLA *Mann.* One specimen, under bark.

BYRRHIDÆ.

PEDILOPHORUS ACUMINATUS *Mann.* A single specimen was taken at rest upon a freshly cut spot on the trunk of a large conifer.

ELATERIDÆ.

ATHOUS FERRUGINOSUS *Esch.* One specimen.

MORDELLIDÆ.

ANASPIS RUFA *Say.* Two or three examples were taken on flowers.

CURCULIONIDÆ.

PLINTHUS CARINATUS *Boh.* One example, on a log.

CALANDRIDÆ.

RHYNCHOLUS BRUNNEUS *Mann.* One specimen, under bark.

SCOLYTIDÆ.

XYLOTERUS BIVITTATUS *Kirby*. Rather common; a number of specimens were taken under the bark of a fallen conifer.

PORT CHESTER, ALASKA.

CARABIDÆ.

PTEROSTICHUS VALIDUS *Dej*. On the hills, under logs and slabs of wood.

PTEROSTICHUS AMETHYSTINUS *Dej*. Not common.

PTEROSTICHUS CASTANEUS *Dej*. Quite rare.

HYDROPHILIDÆ.

CERCYON FULVIPENNE *Mann*. One or two specimens, among refuse near the beach.

PSELAPHIDÆ.

BATRISUS ZEPHYRINUS *Casey*. One specimen under a log.

STAPHYLINIDÆ.

QUEDIUS CAPUCINUS *Grav*. Several specimens were taken along the beach, in refuse, also a few higher up, among the hills.

TACHINUS DEBILIS *Horn*. Rare; found with the preceding.

ELATERIDÆ.

MEGAPENTHES STIGMOSUS *Lec*. One specimen on flowers.

MORDELLIDÆ.

ANASPIS RUFA *Say*. One or two specimens on flowers.

STIKINE RIVER, BRITISH COLUMBIA.

All captures given under this heading were made, unless otherwise noted, at the lower end of the Little Canon.

CICINDELIDÆ.

CICINDELA OREGONA *Lec.* Three or four specimens of *C. repanda*, referable to this variety, were found on a little sand bar. They were so sluggish as to be easily captured by hand.

CARABIDÆ.

CYCHRUS ANGUSTICOLLIS *Fisch.* One specimen of this species, taken beneath a log, does not differ from the Coast form.

CYCHRUS MARGINATUS *Fisch.* A few examples found here are less metallic and have the elytral margin less brilliant than those found on the Coast, resembling in these particulars the variety I have elsewhere recorded from Montana (Ento. News, I., p. 33). The thorax is also apparently a trifle broader in proportion to its length.

ELAPHRUS PALLIPES *Horn.* Rare under leaves and sticks on the flats.

OPISTHIUS RICHARDSONII *Kirby.* One or two specimens were washed out of the river bank just above the Canon.

NOTIOPHILUS SYLVATICUS *Esch.* One example, under leaves.

NEBRIA METALLICA *Fisch.* Several specimens of a very pretty color variety were found, usually in hollows filled with dead leaves but sometimes under sticks.

BEMBIDIUM FUNEREUM *Lec.* Not rare, under leaves.

BEMBIDIUM QUADRIFOVEOLATUM *Mann.* Taken with the preceding.

TRECHUS CHALYBEUS *Mann.* Common under leaves and sticks, all over the bottom.

PTEROSTICHUS VITREUS *Dej.* Rare, under pieces of wood, with the next.

PTEROSTICHUS LUCZOTII *Dej.* One specimen.

PTEROSTICHUS RIPARIUS *Dej.* Rather common; a very agile little species, taken mostly under leaves. A single specimen was also found at a camp several miles farther up the river.

CALATHUS INGRATUS *Dej.* One specimen.

PLATYNUS PICEOLUS *Lec.* Not rare, may be found in damp spots under any shelter.

HYDROPHILIDÆ.

CERCYON FULVIPENNE *Mann.* One specimen, in dung.

SILPHIDÆ.

SILPHA LAPPONICA *Herbst.* Rare, found running about the camp.

ANISOTOMA LATERITIA *Mann.* Two or three specimens taken here are doubtfully referred to this species.

AGATHIDIUM REVOLVENS *Lec.* Two specimens under dead leaves.

STAPHYLINIDÆ.

ATHETA FUNGI *Grav.*

ATHETA DENTICORNIS *Fauvel* (*in litt.*).

HETEROTHOPS DENTIVENTRIS *Fauvel* (*in litt.*). Occurs with the following species.

HETEROTHOPS FUMIGATUS *var.* CALIFORNICUS *Lec.* Rather rare under damp leaves in little hollows.

QUEDIUS LIMBIFER *Horn.* Rare, under rubbish.

QUEDIUS HYPERBOREUS *Er.* One specimen only.

QUEDIUS LÆVIGATUS *Gyll.* One specimen.

CREOPHILUS VILLOSUS *Grav.* Found about the camps but by no means abundantly.

PHILONTHUS SIEGWALDI *Mann.* Not common, occurs under rubbish.

BAPTOLINUS MACROCEPHALUS *Nordm.* Rare, under bark.

STENUS SECTATOR *Casey.* Rare, on the river bank.

STENUS MAMMOPS *Casey.* One specimen.

TACHINUS NIGRICORNIS *Mann.* Around filth and camp refuse, not rare.

BOLETOBIUS *sp.* One or two specimens, presumably of an European species, were taken here.

MYCETOPORUS SPLENDIDUS *Grav.* Rare, in fungi.

OXYPORUS STYGICUS *Say.* One specimen, from a fungus.

PORRHODITES FENESTRALIS *Zett.* Rare. Taken in the early morning from the tent covers.

LATHRIMÆUM ATROCEPHALUM *Gyll.* Rare, found with the preceding.

DELIPHRUM BREVICOLLE *Mækl.* Rare.

OLOPHRUM PARCUM *Lec.* (*in litt.*). Two or three examples, with *Lathrimæum*. Captain Casey writes me that the species is known by the above name in the Leconte cabinet.

ANTHOBIUM POTHOS *Mann.* Not common, occurs on flowers.

CUCUJIDÆ.

PEDIACUS FUSCUS *Er.* Rare, found on the tents in early morning.

CRYPTOPHAGIDÆ.

HENOTICUS SERRATUS *Gyll.* On the tents, in the morning, with the next two species.

CÆNOSCELIS CRYPTOPHAGA *Reitt.* One specimen.

ATOMARIA *sp.* Not common.

DERMESTIDÆ.

DERMESTES LARDARIUS *Linn.* Taken in the camp, somewhat rarely.

NITIDULIDÆ.

EPURÆA AVARA *Rand.* One specimen, from my tent.

LATHRIDIIDÆ.

CORTICARIA SERRICOLLIS *Lec.* One specimen, from the tents.

CORTICARIA *sp.* One example, with the preceding.

TROGOSITIDÆ.

CALITYS SCABRA *Thunb.* One example, smaller than the average, was taken from an old stump.

ELATERIDÆ.

THAROPS RUFICORNIS *Say.* Found running over a fallen trunk of cottonwood. One example.

CRYPTOHYPNUS NOCTURNUS *Esch.* Several examples were found under a dry log, on top of the hill at the lower end of the Canon.

ELATER BEHRENSII *Horn.* One specimen was given me by a miner.

ATHOUS FERRUGINOSUS *Esch.* Rare, on herbage or flying.

CORYMBITES UMBRICOLA *Esch.* One specimen, without notes.

BUPRESTIDÆ.

MELANOPHILA ATROPURPUREA *Say.* Rare, in the camp.

BUPRESTIS FASCIATA *var.* LANGII *Mann.* A specimen of this species was given me by Jules Carle, a miner; he took it somewhere on the river, but whether at the Canon or farther up is uncertain.

LAMPYRIDÆ.

PODABRUS SCABER *Lec.* One example.

MALACHIIDÆ.

DASYTES HUDSONICUS *Lec.* Two or three specimens were found on the tents.

SCARABÆIDÆ.

AEGIALIA RUFESCENS *Horn.* One specimen at the Canon, under leaves; three or four more were found farther up the river, beneath a chip of wood half buried in the sand.

AEGIALIA CYLINDRICA *Esch.* Rare, among dead leaves in the river bottom.

CERAMBYCIDÆ.

ASEMUM MŒSTUM *Hald.* A specimen, in very bad condition, was among the insects brought back by Mr. Carle.

XYLOTRECHUS UNDULATUS *Say.* One specimen, Mr. Carle.

LEPTALIA MACILENTA *Mann.* One example, in the camp.

PACHYTA LITURATA *Kirby.* To this species I refer three examples, given me by Mr. Carle. They are much larger than a specimen from Laggan, Alberta, given me by Mr. Bean, and with the dark markings of the elytra much more distinctly defined.

LEPTURA CANADENSIS *Fab.* One specimen, on tent cover.

MONOHAMMUS SCUTELLATUS *Say.* Three specimens, from Mr. Carle.

TENEBRIONIDÆ.

PHELLOPSIS OBCORDATA *var.* PORCATA *Lec.* Two specimens were found on a woody fungus.

UPIS CERAMBOIDES *Linn.* From Mr. Carle. Two specimens.

SCAPHIDEMA PICTUM *Horn.* An individual was found here, with the upper surface of a uniform greenish black, very different from the variegated form found in Northern Idaho.

CEPHALOIDÆ.

CEPHALOON TENUICORNE *Lec.* One specimen, at rest in the camp.

CALANDRIDÆ.

RHYNCHOLUS BRUNNEUS *Mann.* One specimen, under bark.

GLENORA, BRITISH COLUMBIA.

CICINDELIDÆ.

CICINDELA REPANDA *var.* OREGONA *Lec.* Along the river bank, here, and also a little farther up, at Buck's Bar.

CARABIDÆ.

OPISTHIUS RICHARDSONII *Kirby*. Rare, on the river bank.

NEBRIA METALLICA *Fisch*. Under logs and debris along the bank of the river, in company with the three following:

NEBRIA HUDSONICA *Lec*. Very rare.

NEBRIA SAHLBERGI *Fisch*. More numerous in specimens than either of the preceding, but still not common.

NEBRIA MANNERHEIMII *Fisch*. Three specimens.

BEMBIDIUM PLANATUM *Lec*. Two specimens, on the river bank.

BEMBIDIUM PLANIUSCULUM *Mann*. Rare.

BEMBIDIUM QUADRIFOVEOLATUM *Mann*. Under debris, in wet places.

BEMBIDIUM STRIOLA *Lec*. A single specimen, varying from the typical form, is referred here.

BEMBIDIUM LUCIDUM *Lec*. One specimen.

BEMBIDIUM MORULUM *Lec*. A very few of these were found well up on the hills, under burnt logs.

PATROBUS ATERRIMUS *Dej*. Along the river bank under rubbish not common.

PTEROSTICHUS LUCZOTII *Dej*. One specimen, with the preceding.

PTEROSTICHUS RIPARIUS *Dej*. Rare, near the river.

AMARA REMOTESTRIATA *Dej*. One specimen, under a log.

AMARA BRUNNEA *Gyll*. Two or three examples, with the preceding.

CALATHUS IMPUNCTATUS *Say*. One specimen.

PLATYNUS PICEOLUS *Lec*. Not common, along the river.

HARPALUS CAUTUS *Dej*. Two or three specimens, under pieces of wood.

HARPALUS RUFIMANUS *Lec*. One specimen.

SILPHIDÆ.

SILPHA LAPPONICA *Herbst*. I did not see many specimens,

though it is said to be at times very destructive to dry and drying salmon, which forms an important article of food all along the river. It is called by the residents and miners, the "Salmon bug,"

CHOLEVA LURIDIPENNIS *Mann.* One specimen in dung.

STAPHYLINIDÆ.

ATHETA SUSPECTA *Fauvel* (*in litt.*). Common in fungi.

ALEOCHARA MŒRENS *Er.* In fungi, not rare.

OXYPODA *sp.* In fungi.

GYROPHÆNA BIHAMATA *Thoms.* Not common, in fungi.

STENUS BIPUNCTATUS *Er.* One example, near the river.

TACHINUS SEMIRUFUS *Horn.* In refuse on the river beach, rare.

OXYPORUS RUFIPENNIS *Lec.* One individual, in a fungus.

PLATYSTETHUS AMERICANUS *Er.* Very common, in dung.

OMALIUM PUSILLUM *Grav.* Taken under bark, in company with some Scolytidæ. Rare.

CRYPTOPHAGIDÆ.

ATOMARIA *sp.* Rare, on wood.

BYRRHIDÆ.

CYTILUS TRIVITTATUS *Melsh.* Rare, on the hill-sides, under burnt logs. This apparent preference of Byrrhidæ for burnt wood has been noticed by me elsewhere. (Ento. News, I., p. 34).

ELATERIDÆ.

CRYPTOHYPNUS NOCTURNUS *Esch.* Rare, on hill-sides, under burnt logs.

BUPRESTIDÆ.

BUPRESTIS STRIATA *var.* LANGII *Mann.* One specimen was taken on a building, another was given to me as coming from Buck's Bar, six miles farther up the river.

MALACHIDÆ.

DASYTES HUDSONICUS *Lec.* One specimen, without record.

LUCANIDÆ.

PLATYCERUS DEPRESSUS *Lec.* One specimen was found beneath a log.

CERAMBYCIDÆ.

LEPTURA SUBARGENTATA *Kirby.* A single specimen, on flowers.

CHRYSOMELIDÆ.

ADIMONIA EXTERNA *Say.* One example of this fine species was found beneath a log.

MELANDRYIDÆ.

TETRATOMA CONCOLOR *Lec.* Found rarely, in fungi.

HALLOMENUS PUNCTULATUS *Lec.* Found rarely, in fungi.

CURCULIONIDÆ.

TRICHALOPHUS CONSTRICTUS *Lec.* A specimen, without head or thorax, was found on the hill-sides, and is doubtfully referred here.

CEUTORHYNCHUS *sp.* Several specimens of a small species were beaten from herbage.

SCOLYTIDÆ.

DRYOCŒTES AFFABER *Mann.* Dug from a log, in some numbers.

POLYGRAPHUS RUFIPENNIS *Kirby.* With the preceding, but rare.

In order to show some of the geographical relations of the Coast and Stikine River I have made out the subjoined table; and while the deductions made therefrom cannot be considered

mathematically exact they are at least approximately correct, and, it is hoped, will save those interested much weary labor in searching for data. Some of the lists were not easily compared, one or two being encumbered with much synonymy that had to be unraveled before any definite results could be arrived at. The following have been used, as the best exponents of the faunæ to which they relate.

The Coleoptera of Michigan. H. G. Hubbard and E. A. Schwarz. Here are listed 1231 species and varieties from Lake Superior, and 1786 from the lower peninsula of Michigan.

List of Ottawa Coleoptera. W. H. Harrington.

List of Coleoptera by Dr. A. S. Packard in his work on "The Labrador Coast."

Vega-Coleoptera und Hemiptera. I have used the list given by Dr. Bergroth in Entomolog. Nachrichten, 1885. This relates to the insects brought back by the Vega from Behring Strait and the Chuck-chee peninsula.

Catalogue of the Coleoptera of Mt. Washington, N. H. E. P. Austin.

Notes on Coleoptera found at Fort Simpson, Mackenzie River. Dr. J. L. Leconte. I owe to the kindness of Dr. John Hamilton, a manuscript copy of this list.

The Coleoptera of the Alpine Rocky Mountains, Parts I and II. Dr. J. L. Leconte.

With this mention, the following table explains itself: The first column of figures shows the number of species, of that part of the Alaskan Coast treated of in the foregoing pages, which are found also in the localities set opposite: the second and third columns dealing in the same way with those of the Stikine Canon and Glenora. The fourth, fifth and sixth columns show what percentage of the fauna of their respective headings is derived from, or common to, localities of which lists are compared.

TABULAR COMPARISON OF LISTS.

	Found also in Alaska.	*Found also at Little Canon.*	*Found also at Glenora.*	*Percent. in Alaska.*	*Percent at Little Canon.*	*Percent at Glenora.*	*No. of species in List.*
Lake Sup...	22....	22....	17....	22....	37...	42.5..	1231
Mich. Pen..	14....	15....	8....	14....	25...	20 ..	1786
Ottawa.....	17....	14....	6....	17....	23...	15 ..	1022
Labrador...	3....	6....	4....	3....	10...	10 ..	53
Behring St..	1....	0....	0....	1....	0...	0 ..	57
White Mts..	10....	11....	5....	10....	18...	12.5..	221
Ft. Simpson.	0....	4....	3....	0....	7...	7.5..	25
Rocky Mts..	12....	10....	16....	12....	17...	40 ..	818
So. Alaska[1]	—....	20....	4....	—....	33...	10 ..	118
Stikine Can.	20....	—....	11....	20....	—...	27.5..	71
Glenora.....	4....	11....	—....	4....	18...	——..	46

These figures would seem to indicate:

1. That the fauna of Southern Alaska is less closely related to our alpine, northern inland, or north-east coast faunæ than is that of the Stikine Canon or of Glenora.

2. That the Stikine Canon fauna is more closely allied to that of the North and East than is that of the coast, and about the same as is that of Glenora.

3. That the chief relations of all three are in the direction of Lake Superior: with larger lists this affinity might turn to the Rocky Mountains, especially in the case of Glenora.

Regarding the affinities of the faunæ of the Coast, the Stikine Canon and Glenora among themselves we find:

4. That one-sixth of the Coast species extend up to the Canon while only one-thirtieth reach Glenora.

5. That the last-named fauna is much more nearly allied to that of the Canon than to that of the Coast; nearly one-

[1] In making out percentages, this and the two following have been reckoned at 100, 60 and 40 respectively, as several of the Aleocharini are not available for comparison with other lists on account of bearing only manuscript names, and of this group not having been worked over in compiling most of the catalogues consulted.

fourth of the Glenora species are found also at the Canon while only about one-eleventh extend to the Coast.

6. That the fauna of Glenora is apparently less related to that of the Coast than to that of the interior or of the North-east; and

7. That the fauna of the Canon is more closely related to that of the Coast than to that of the interior or the East.

Reference to the accompanying maps will throw some light on the problems here suggested. Glenora is on the inside of the great Coast Ranges while the Little Canon is regarded by Dr. Dawson as marking the head of the old salt-water inlet that has been silted up. This would account for much in the distribution of the species in question. The climate of the country above the Canon is also much dryer and with greater extremes of heat and cold than on the Coast. Aside from the influence of the barrier of the Coast Mountains interposed between faunæ which might tend to intermingle, the change of plants consequent upon difference in climate on opposite sides must also have its effect on the insects dependent on vegetation for food.

These, then, are the conclusions as to probable faunistic affinities to which our figures seem to lead us; and while they may be modified with larger collections before us, it is hoped that these notes, made before the hand of civilization has swept away the native fauna and replaced it by one of its own, will not lose their value.

ON TWO SPECIES OF COLEOPTERA INTRODUCED FROM EUROPE.

By H. F. WICKHAM.

During the summer of 1887, a specimen of the common European *Aphodius fossor* Linn. was captured at Iowa City. This species was introduced into the New England States many years ago and has thus far been reported from New Hampshire, Vermont, Canada (Ottawa and Trenton), and Detroit, Michigan. I have not heard of its occurrence farther west than Iowa City and it has been taken here but once. It will be interesting to note whether it will increase in numbers to such an extent as its relatives, *A. granarius*, *A. inquinatus* and *A. fimetarius*—all originally European though now more common than any of the native species in this part of the State.

After a recent visit of his to the South-western part of Iowa, Prof. Shimek handed me, among other Coleoptera which he had taken there, a species of *Rhinoncus*. This I sent to Dr. Wm. G. Dietz, of Hazleton, Pa., a competent authority on Rhynchophora, and he pronounced it a typical specimen of *Rhinoncus inconspectus* Hbst., a species well known in Europe, but not until now noticed as a member of our fauna. Two other European species of this genus are already naturalized in America and it is likely that this also has come to stay.

PLATE I.

Dicælus splendidus Say.

Fig. 1. Larva, full grown, about natural size
Fig. 1*a*. Pupa, front view.
Fig. 1*b*. Pupa, side view.
Fig. 1*c*. Maxilla.
Fig. 1*d*. Mandible.
Fig. 1*e*. Surface of ventral segment showing arrangement of plates.

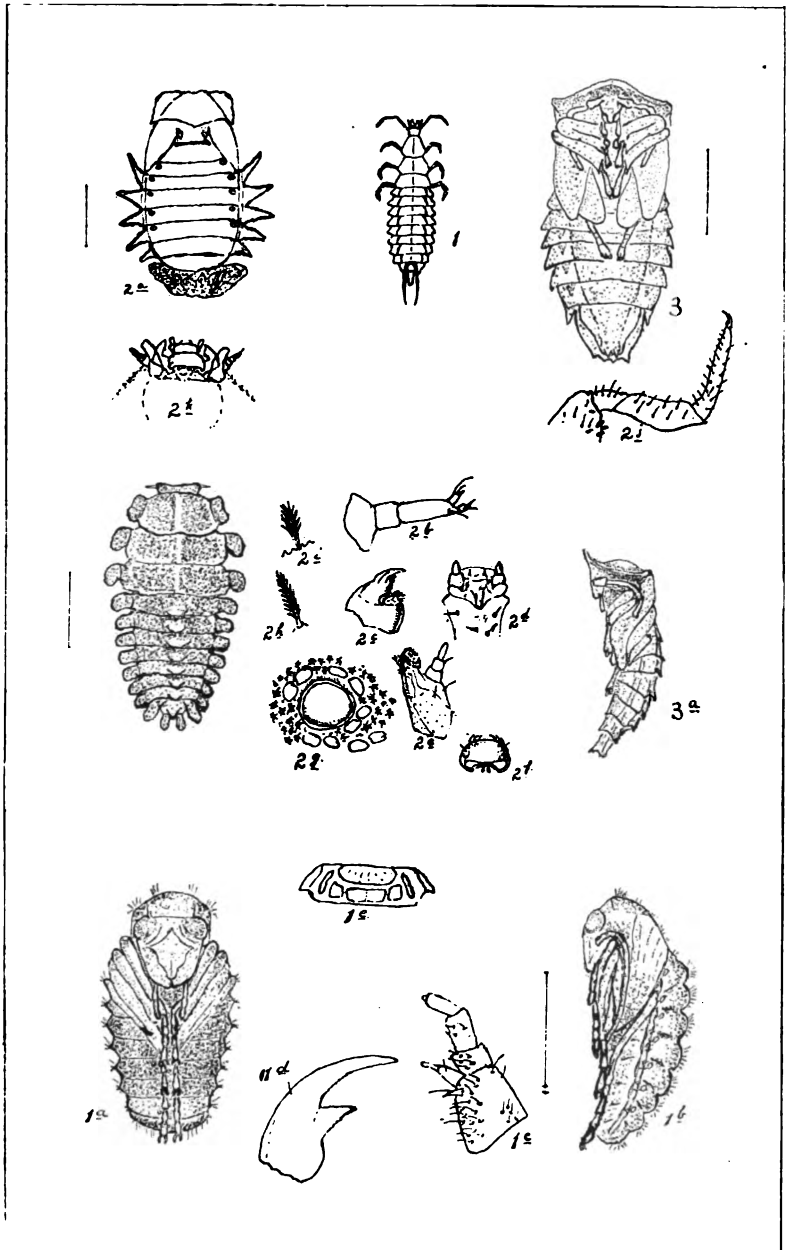
Epipocus cinctus Lec.

Fig. 2. Larva, from above.
Fig. 2*a*. Pupa, dorsal view.
Fig. 2*b*. Antenna.
Fig. 2*c*, 2*d*, 2*e*, and 2*f*. Mouth parts, dissected.
Fig. 2*g*. Abdominal spiracle, much enlarged.
Fig. 2*h* and 2*i*. Scales, highly magnified.
Fig. 2*j*. Leg, anterior.
Fig. 2*k*. Mouth parts *in situ*.

Ellychnia californica Mots.

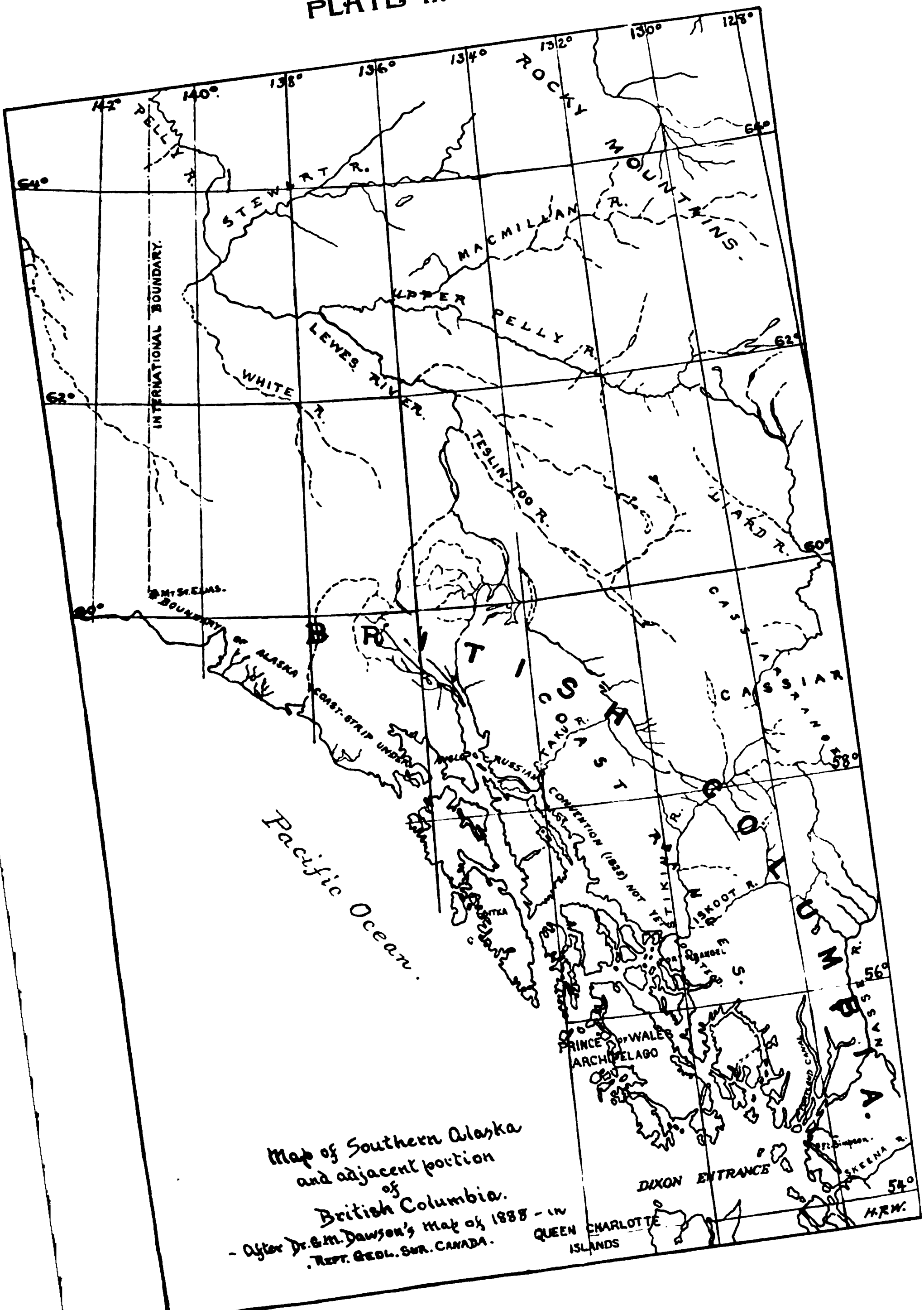
Fig. 3. Pupa, front view.
Fig. 3*a*. Pupa, side view.

PLATE I.



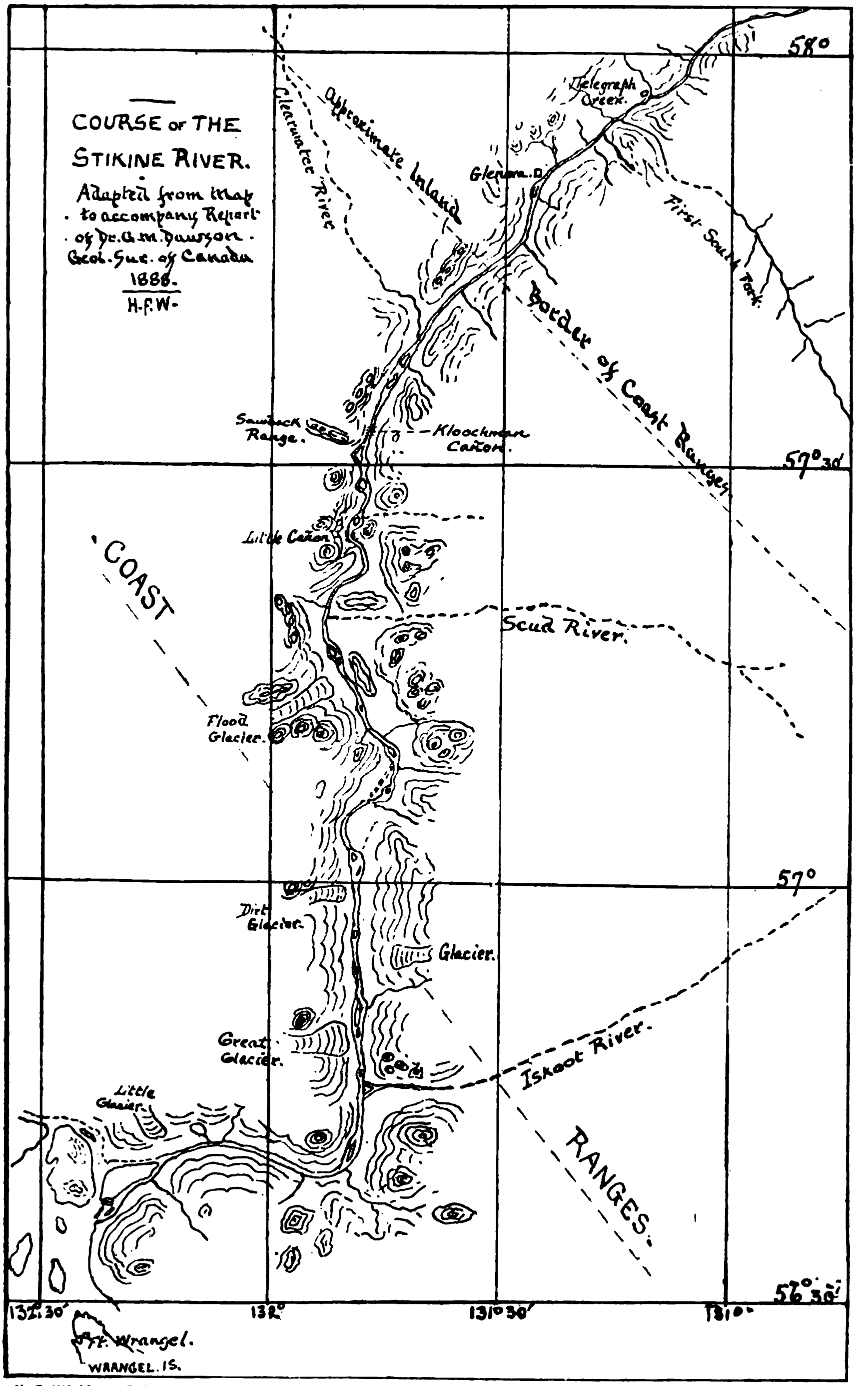
H. F. WICKHAM, DEL.

PLATE II.



H. F. Wickham, Del.

PLATE III.



H. F. Wickham, Del.

REPORT ON ZOOLOGICAL EXPLORATIONS ON THE LOWER SASKATCHEWAN RIVER.

By C. C. NUTTING.

During the months of July and August, 1891, the writer, accompanied by Messrs. Frank Russell and A. G. Smith, was engaged in collecting and studying the animals, particularly mammals and birds, of the lower Saskatchewan River. Few persons who have not visited that region have an accurate conception of the extent of the water systems in British America. Here is a river, navigable for fourteen hundred miles, emptying into a lake nearly three hundred miles long, and both are little more than names to most people. Lake Winnipeg receives most of its waters from two sources, the Red River of the North flowing from the south into its southern end, and the Saskatchewan River, flowing in an easterly direction from the foot-hills of the Rocky Mountains to the northern end of the lake, a distance of almost two thousand miles, as the river winds. Lakes Winnipegosis and Manitoba, a short distance to the west of Winnipeg, are connected with each other by the Waterhen River, and with Lake Winnipeg by the Little Saskatchewan River. Lake Winnipeg is connected with Hudson's Bay by Nelson River, the whole forming a water system of vast extent, draining a region from the Rocky Mountains to Hudson's Bay; a system almost comparable in extent to that of the Mississippi River. From the Saskatchewan River to the Polar Sea is one inextricable maze of lakes, rivers and marshes, one of the greatest palustral regions in the world, perhaps, and the breeding place of most of our migratory birds.

The American Continent, from the Gulf of Mexico to the Arctic Ocean, offers no barrier to distribution or migration, thus presenting an exceptional opportunity for the study of geographical distribution unimpeded by barriers, as well as an almost unequalled field for the investigation of the problem of the migration of birds, a migration which in some species, at least, extends through a distance of sixty degrees of latitude, or over four thousand miles on the American Continent.

The region which forms the subject of this report is one of unusual zoölogical interest, being to a certain extent characterized by an intermingling of eastern and western, arctic and temperate faunæ. So far as I was able to ascertain, no naturalist had ever worked in this immediate region before our advent. Two main stations were occupied, from which side excursions were made. Our first station was at the Hudson's Bay Company's Post, at Grand Rapids, where the Saskatchewan River empties into Lake Winnipeg, at about latitude 53°, 10′; long. 90° 30′. Besides the Hudson's Bay Post, there is a station of the A. Booth Packing Company of Chicago, whence the famous Lake Winnipeg white fish are sent to the markets. Our party was indebted to the agent of this company for the comfortable house in which we lived and worked while at Grand Rapids. The whole region is covered with dense forests of conifers and poplar. There is quite a high ridge of rock which reaches the lake about three miles north of the mouth of the Saskatchewan River. The formation is Upper Silurian and the principal paleontological feature is a fine brachiopod *Pentamerus decussatus*, of which our party secured a large series.[1]

In the vicinity of the fort, and for some distance to the south-west, the land is at least not under water, but to the south, back from the river, the country is what is locally termed "muskeg," a region harder to penetrate and work in than any other ever seen by the writer, who has had some experience both in the Rocky Mountains and the Tropics.

[1] See Vol. II, No. 2, of this Bulletin.

Imagine a perfectly flat region covered with a dense forest of *dead* conifers, which have fallen over each other in a perfect maze, here piled up and there scattered as if by a cyclone among the still numerous standing trees. Imagine a thick growth of wiry bushes and rank grass to have interlaced itself with the fallen tree tops, stumps and trunks, the ground being covered with standing water from six inches to three or four feet deep. Such is the muskeg, a country offering almost insurmountable difficulties to the explorer or hunter. The inanimate obstacles are bad enough, but when dense clouds of vicious mosquitoes, swarms of "black flies," and hordes of immense horse-flies, called "bull dogs," are added, it will be seen that naturalizing in such a region is no holiday sport. The stoutest clothes are torn to tatters after a few hours of plunging through the half submerged bushes and snags, the stoutest heart quails before the onslaught of the mosquitoes[1], and the staunchest morality grows shaky under the attacks of the terrible black flies, which draw blood at every bite.

On one occasion we were forced to spend a night trying to work a canoe down a stream which ran through the muskeg, and a more pitiable lot of naturalists could not be imagined than appeared at our camp next morning. Mr. Russell's face was so swollen that his eyes were shut tight, incapacitating him for work. Mr. Smith and myself came near meeting the fate of the last survivors in Byron's "Dream of Darkness:" "Even of their mutual hideousness they died." I dwell upon this for the purpose of giving some idea of the most characteristic feature of the region, and the severe hardships which must be endured by the naturalist in the muskeg, which covers thousands of square miles in the North-West Territories of Canada.

[1] S. H. Scudder, in his "Winnipeg Country," grows eloquent on the subject of these mosquitoes, which he calls "The yellow-jackets of Culex land, illimitable in numbers, ubiquitous, insatiable, indomitable, hot-tongued, with all the spirit of the Furies."

The Hudson's Bay Company is all powerful throughout the entire Saskatchewan country, and indeed all of Northern British America. It has absolute control in fact, if not in name, of every Indian in that domain, and the result is highly creditable to the company. I had my tent pitched in the middle of a settlement of the Swampy Cree Indians for several weeks. I could speak no Cree, and very few of them any English. In my tent was wealth, in their eyes, in the shape of ammunition, camping outfit, guns, provisions, etc., which was daily left unprotected, and not a cent's worth was taken. I could not help the reflection that such a procedure would not be safe in any American village of my acquaintance. The Hudson's Bay Company *has always kept its word with the natives*, correctly representing the quality of all goods sold to them. Absolutely no liquor is sold to the Indians so far as we could ascertain, and the result is that the Swampy Cree, although shiftless and improvident to the last degree, *is honest*, and his word can be depended upon. During hard winters the company will tide over the Indians by supplying them with provisions on trust, and I was told by the company's agent that these debts were almost never repudiated.[1]

Our second station was the Cree village of Chemawawin, about sixty miles to the west of Grand Rapids. To reach it we went around the Rapids by a portage, and up the Saskatchewan River to Cross Lake, about ten miles wide, and then to the "Narrows," near the spot where Cedar Lake finds an outlet via the Saskatchewan. Clear Lake is said to be forty miles wide, and Chemawawin is near the spot where the Saskatchewan enters the lake. This latter point, by the way, is regarded by the inhabitants as the true mouth of the Saskatchewan River, although Grand Rapids is doubtless

[1] Of course it can be said that the Indians are completely in the Hudson's Bay Company's power, and so are forced to pay; but it is equally true that our western Indians are completely in the power of the United States Government, but a comparison of the results would be a sad commentary on our Indian policy.

better entitled to the honor; for here the magnificent stream at last debouches into the broad expanse of Lake Winnipeg.

There was considerable excitement at the time of our visit, over the discovery of amber on the shores of Cedar Lake. Amber certainly is found there, but so far in such small pieces that its value cannot be very great; but the amber fever was raging fiercely, and an otherwise sensible gentleman calmly informed me that he thought there was half a million dollars worth of amber on his claim, and was living in constant terror lest said claim be jumped.

Excellent examples of the power of ice to transport rock are found on the southern shore of this lake, where masses of boulders have been shoved up on the bank in wild confusion.

The village of Chemawawin is composed of, perhaps, twenty tepees or lodges of Indians, who subsist largely on the white-fish and sturgeon, abounding in the river. In winter they hunt and trap, exchanging the proceeds for blankets, clothing and provisions at the Hudson's Bay Post, about a mile from the village. They have their own school taught by Mr. Bear, an educated Cree Indian, and religious truth is dispensed to them by the Rev. Mr. Sinclair, of the Church of England. A more simple minded and honest set of people I never saw. Improvidence, as before indicated, is their besetting sin, and they often go hungry in consequence. They are skilful in canoe building, the most beautiful canoes that I have ever seen being the work of these Indians. I was told that a good canoe could be bought for ten or fifteen dollars. The immense swamps and marshes around Chemawawin, and for many miles up the river, are the homes of myriads of water birds. Ducks and geese are in incalculable numbers, together with various less useful species. Swamp loving *Icteridæ* are there in force, and the mosquitoes are simply appalling.

CLASS MAMMALIA.

Nothing more than a fragmentary list of the mammals of this region can be given. Indeed, it may be regarded as merely a preliminary list, which it is hoped will be greatly extended in the near future by the researches of Mr. Frank Russell, who is now working in that region in the interests of this University.

ORDER RODENTIA.

LEPUS AMERICANUS Erxleben. A hare described by the natives is either this or *L. campestris*.

ERETHIZON DORSATUS (L). *Porcupine*. The quills of this animal are used by the Canadian Indians to ornament their birch bark work. The Iroquois especially, are skilled in dyeing these quills in brilliant colors, and working them into fancy patterns in their birch bark baskets, mats, etc.

CALOYMS MICHIGANENSIS (Aud. & Bach.). *Mouse*. One specimen secured at Chemawawin.

CASTOR FIBER (L). *Beaver*. It is somewhat doubtful whether the beaver occurs at present in the region under consideration. One Indian seems to think that it is still to be seen, but Hudson's Bay officers consider it scarce, and it does not figure in their yearly returns of furs.

FIBER ZIBETHICUS (L). *Musk Rat*. "*Musquash*" of the Indians. This is really the most important fur-bearing animal of the lower Saskatchewan. We saw immense bales of their skins packed for shipment. The skins are stretched on frames to dry, the frames being fitted inside the skins, which are stretched fur side in and packed in bales, each bale containing, apparently, thousands of skins. The vast extent of swamp and muskeg must be a veritable paradise for this animal, which seems to fairly hold its own in spite of the yearly

wholesale slaughter. The "musquash" plays a prominent part in the Swampy Cree account of the creation, and appears in much of the folk lore of that region.

TAMIAS ASIATICUS Gmelin. *Chipmunk.* Common. One specimen secured.

SCIURUS HUDSONIUS Erxleben. *Chickaree* or *red squirrel.* So far as we could ascertain, the only representative of the genus in the Saskatchewan country, and the most conspicuous rodent around the Post of Grand Rapids, where it is even more impudent and inquisitive than our common species. Being seldom shot or molested by the natives, and spry enough to keep out of the way of the pine marten, it thrives and multiplies with little let or hindrance. Hawks are not numerous, and so the little chickaree, free from the competition of the larger squirrels, and not greatly persecuted by enemies, is getting along very well in the struggle for existence, and will doubtless survive nearly, if not quite, all the larger mammalia of that region, even the "musquash," which is so unfortunate as to be useful to man in furnishing an important item in the Hudson's Bay Company's annual shipment. A fit example of the *survival of the insignificant.*

ORDER UNGULATA.

CERVUS CANADENSIS Erxleben. *Wapiti. American Elk.* Mr. Angus McLean, of the Hudson's Bay Company, informed me that these animals were to be found within about thirty miles of Grand Rapids, and Mr. Hine, of Winnipeg, said that they were most numerous "between the lakes," that is, between Lake Manitoba and Lake Winnipeg.

ALCE ALCES (L). *Moose.* This noble animal is the most common herbivore in the Saskatchewan region. Numbers are killed yearly near Grand Rapids, and two specimens, male and female, have been sent to our museum by an Indian hunter employed at the time of our visit. The

writer made every effort to successfully stalk the moose in summer, but met with complete failure. The Indians claim to be able to do this, but although the most noted hunters were employed by me, they failed as completely as I did. Indeed, I cannot see how it is possible to trail these wonderfully alert animals through the woods in summer, without making some noise. The ground is usually boggy, and even an Indian will make a noise when withdrawing his foot from a mud-hole. Concealed dry twigs are everywhere, and being hidden in the moss with which the ground is carpeted, it is impossible to avoid cracking them, and then away goes your moose! During the hottest weather in July, and early August, the moose are fearfully tormented by the large horse-fly, called by the English speaking residents "bull dog." These blood-thirsty insects are said at times to actually worry the huge mammals to death. At such times the moose spend the heat of the day in the water of the numerous lakes, where they wade around up to their flanks in water, and graze off the aquatic plants, which grow in great profusion at the bottom of the lakes. This is a time when the moose can be successfully hunted in summer. It is not a very difficult thing for an ordinarily skilled sportsman to get between the game and the shore, and have the moose practically at his mercy. Several were killed in this way at the time of our visit, but, unfortunately, the Indians cut them up at once and spoiled them for specimens. The man who acted as my cook, a French Canadian by the name of Antoine,[1] told me a number of interesting facts about the moose, and as these facts were generally corroborated by the Hudson's Bay men, they are all well worth recording.

The moose, although an animal of very acute hearing, starting at the breaking of the smallest twig, has not yet

[1] Antoine, by the way, was one of the party that thirty years ago, under the direction of Dr. Lea, succeeded in finding most of the relics of the lamented Sir John Franklin and party. Many an intensely interesting yarn he had to tell of that remarkable and historic expedition.

learned to fear the report of a gun. If the hunter can keep himself concealed, he may get several shots at the same animal before it realizes the situation. A moose will sometimes stand and unconcernedly look at a man for some moments, if the latter is to the leeward and remains motionless. At the slightest movement, however, the huge brute is off in a twinkling.

During a wind-storm these animals often "get crazy" as the Indians say. That is, they will start to run and keep going, not in any particular direction, but hither and thither, as if they had actually lost their senses. When they once commence this sort of performance, the Indian hunter refuses to attempt to trail them, regarding it as a waste of time. At such times the senses of the moose seem unusually acute, and although branches may be breaking all around them by the force of the wind, they are said to instantly detect the snapping of a twig under a hunter's foot.

The oft repeated story of the manner in which the moose attempts to elude the hunter is corroborated by every Indian I have talked with. Briefly, it is as follows:

The moose, after finishing his browsing for the day, betakes himself to the deep woods or muskeg, and having penetrated some distance, will make a long circuit leeward, and come back to within a short distance of his own trail where he lies down, thus making it sure that he will get the scent of any one following on his trail. The hunter, knowing this ingenious ruse, will, upon finding that the trail is quite fresh, make long detours to the leeward, until he finally strikes the loop made in the trail by the moose before lying down, and thus get the wind of his game.

The Cree hunter always cuts out the liver, heart and as much of the other viscera as he can carry, immediately after the moose is killed. This is eaten, often raw, the first thing after reaching camp, no salt even being used. This eating of the viscera seems to partake of the nature of a religious ceremony. To allow a dog to eat a portion of the heart of a moose is bad luck, and a friend of mine seriously

offended his Cree hunter by throwing a bit of a moose heart to his dog. The cartilaginous mass forming the greatly enlarged muzzle is considered a great delicacy; that and the tongue being especially prized. In winter these animals are hunted on snow-shoes, as in other parts of Canada.

RANGIFER TARANDUS (L). *American Reindeer.* Common. Not so numerous in summer as in winter. I saw their horns in the possession of natives, and on one occasion struck their trail in the muskeg. The destruction of this animal in the far North must be very great. A postmaster, as those in charge of Hudson's Bay Posts are called, who is located in the Great Slave Lake region, told me that during the winter of 1890–91, *over ten thousand reindeer tongues* had been brought into his post.

Before leaving the notes on *Ungulata*, it may be advisable to mention the fact that a gentleman, who has for years been a missionary in the far North-west, arrived at Grand Rapids while we were there, and announced that he had seen, a few days before, on the shore of Cedar Lake, the freshly dropped manure of an animal belonging to the family Bovidæ. Of course the first thought was that it was simply an evidence of the recent presence of the domestic cow, but it seemed, upon inquiry, that such a thing was deemed next to impossible by Hudson's Bay men. The gentleman said that there were the trails of two animals, neither deer, elk, moose nor caribou, with all of which he was perfectly familiar. The question arises whether or not there is any possibility of the survival of a few buffalo in that region. They were common not far from there only a few years ago, and Mr. McLean thought it about as likely that the droppings spoken of were those of buffalo as of the domestic cow,

ORDER CARNIVORA.

Although we did not meet with a single carnivore except esquimaux dogs, the following species occur in that region, according to the reports of the natives.

URSUS AMERICANUS Pallas. *Black Bear.* Common. A large number of skins are brought in every year. I heard also of a brown species which some hunters claimed was the cinnamon. It could hardly have been *Ursus arctos*, which inhabits Arctic America, but has never, so far as I know, been reported in the Saskatchewan region. I suppose it is merely a color phase of the ordinary black bear.

LUTRA HUDSONICA (Lacipede). *American Otter.* Said to be common.

MEPHITIS MEPHITICA (Shaw). *Common Skunk.* This is one of the standard fur-bearing animals of the region, and this, perhaps, may account for the fact that the name is not held in such disrepute as in more civilized localities. One of our most distinguished Indian friends, a councillor of his village, rejoiced in a title, which being interpreted is "Councillor Skunk."

GULO GULO (L.). *Wolverine.* Formerly common, but now rarely found. The Indians corroborate the story of this animal's habit of defiling any carcasses or provisions which it is unable to devour, and thus rendering it inedible for all other animals. This seems not to be a malicious destruction of food, but a provision for the future needs of the wolverine, which is said to return and eat the food thus preserved. This animal bears the reputation of being among the most cunning of all mammals, and its intelligence in stealing bait and avoiding the traps is the basis of many astounding camp fire-stories.

MUSTELA AMERICANA Turten. *Sable. Pine Marten.* Common. One of the "fur animals" of the region.

PUTORIUS VISON. (Schreber). *Mink.* Common.

PUTORIUS ERMINEA (L.). (?) *Weasel. Ermine.* This animal was mentioned as occurring in the region, but I am unable to state whether it is common or not.

VULPES VULPES (L.). *Red Fox.* Apparently, the com-

monest fox of the region. I saw beautiful skins of this animal at Winnipeg, and was told that the Indians received five dollars apiece for them.

UROCYON CINEREO-ARGENTATUS. (Schreber). *Gray Fox.* Common, but known under several names to the hunters; for example: "*gray fox*," "*cross fox*," "*silver fox*," "*black fox*," etc. The Indians are said to get fifty pounds for a good silver fox skin. If I remember rightly, only one of these rare skins was brought in to Grand Rapids during the season of '90–91.

CANIS LUPUS. (L.). *Wolf.* The wolves of this region are certainly much larger than in more southerly countries. Mr. Hine of Winnipeg has some huge specimens which look fully a third larger than the largest of our timber wolves.

CANIS FAMILIARIAS. (L.). *Esquimaux Dog.* Although not an indigenous species, the esquimaux dog, or "Huskie," is such a conspicuous feature of the region, that an account of the fauna is not complete without some notice of this interesting and useful animal. The impression usually conveyed by the description of travellers is that the esquimaux dog is not a handsome animal, but some of the "Huskies" seen by us were among the noblest looking and finest developed dogs we ever saw. They are often pure white, and as large and heavy as the average Newfoundland, with erect ears and sharp muzzles, giving them an air of intelligence, which does not belie the real character of the animal when he has a chance to cultivate his wits. The Indians club and abuse their dogs mercilessly. I have repeatedly seen the squaws throw ladles of boiling water over the dogs when the half-famished creatures looked too longingly at the "toski," or kettle. The dogs are the only draft animals throughout an immense stretch of territory in British America, and are used as pack animals in the summer. We passed a family of Swampy Crees "on the move," and a strange procession it was, wending its silent way through the sombre forest. First came the old man, about seventy years of age, apparently, with his canoe on his

back; then the faithful squaw with a huge pack of household goods; next a dog, with a kettle on one side, balancing a couple of blankets on the other; then two children trudging along, each with his pack; and, bringing up the rear, another dog, bearing a bundle on either side, the contents of which I could not make out.

Many of the "Huskies" show evidence of wolf blood, particularly in a stiff mane, sharp muzzles, and the "wolf mark," a dark streak on the fore leg. In summer they subsist on the refuse of the camp, but in the winter are barely kept from starving by an occasional fish. Their habit of howling in chorus is also wolf-like, and a concert of this kind will make the air fairly quiver. They do not, however, bark so generally at a stranger as does the ordinary domestic dog. In hot weather they are much distressed by the attacks of the "bull dogs," which get into their hair, and seem to cause them almost unendurable discomfort.

BIRDS.

The primary object of the expedition was to get series of birds is summer plumage, and also the downy young. Owing to the lack of any barrier between the Arctic Circle and the Gulf, the summer residents in the region visited are, nearly all of them, species familiar in Iowa as winter residents or migrants. About ninety per cent of the entire list of species collected by us on the lower Saskatchewan are birds included in the avifauna of Iowa. All the specimens were secured between July 6th and August 25th. They are thus all summer residents, and it will be understood that they are such without any furthur notice of the fact. A full series of the winter residents is expected from Mr. Frank Russell, who is spending the present winter (1892–3) in that region. When his report is published, we may hope for a fairly complete list of the birds of this interesting locality.

Mr. Ernest E. Thompson, of Toronto, has given a full account of the "Birds of Manitoba," published by the Smith-

sonian Institution; and Roderick Ross MacFarlane, Esq., of the Hudson's Bay Company, has published a valuable paper on the "*Land and Sea Birds nesting within the Arctic Circle*," published by the Historical and Scientific Society of Manitoba. Transaction 39; season '88–9. The region treated of in the present report is situated between the two regions included in the publications above referred to.

ORDER PYGOPODES. DIVING BIRDS.

FAMILY PODICIPIDÆ. GREBES.

COLYMBUS AURITUS Linn. *Horned Grebe.* Common at Chemawawin, where it was associated with the pied grebe. The male did not have the prominent ear tufts characteristic of this species, but the rufous streaks on the sides of neck formed a conspicuous marking.

Description of summer plumage: Head below post ocular stripe ashy, darkening above and lightening below, where there is a sharp line of demarcation with the cinnamon of the fore-neck; stripe from base of upper mandible over eye nearly to occiput, yellowish brown; top of head and hind neck, sooty brown; back sooty black; front of neck, fore breast and sides of body cinnamon; rest of under parts white. A phase of coloration not described in works to which I have access.

Young of the year: above sooty brown; head sooty black on top, streaked with white and brown on sides; cheek, chin and throat pure white; neck sooty black behind, light gray or ashy in front, the slightest possible indication of cinnamon on sides; under parts silvery white; bill dusky above for three-fourths its length, the terminal portion of both mandibles being whitish, the upper with a subterminal dusky band; sides of lower mandible dusky above, yellow below.

Breeding in an open pond near the river, opposite Chemawawin. Habits much the same as those of the pied grebe. Iris bright red, surrounded by a white ring. Breeds within the Arctic Circle. (MacFarlane.)

Three specimens secured, 1 ♂, 1 ♀, 1 *juv.*

PODILYMBUS PODICEPS (Linn.). *Pied-billed Grebe.* Abundant on the pond just mentioned. The wonderful expertness exhibited by these birds in diving was a constant source of interest to us. I question the possibility of hitting them if they are so situated that they can see the flash of the gun. The method recommended by Dr. Coues of aiming immediately in front of these birds did not prove a conspicuous success. The best chance is to shoot them as they come up after diving, and before they have time to get their bearing. I was interested on one occasion in seeing a young grebe dive down some distance, and then hold with its bill to a plant at the bottom of the water, which was clear and shallow at that place. The conspicuous stripes on the head and neck of young grebes is hard to account for. The pattern is a bold one, and certainly renders the young birds more conspicuous than the parents, which is an exceptional thing among birds. Perhaps this peculiar streaking is for protection while the young remain on the nest, and in among the reeds, where the streaks would assimilate well with the shadow of the reeds; but out in the open water this coloration certainly seems unfortunate.

Four specimens secured; 1 ♀, 1 *juv.* and 2 in the down.

FAMILY URINATORIDÆ. LOONS AND AUKS.

URINATOR IMBER (Gunn). *Loon.* Common, especially along the south side of Cedar Lake, where the weird, mocking laugh of this uncanny bird was often heard, especially toward evening and in threatening weather. One day, while sitting in the camp on the bank of a stream, one of these birds popped up from the water in front of me. I remained motionless until it dived again, and then ran for my gun. Returning without being seen, I shot the instant it came up again, not giving the bird a chance to get the water out of its eyes. My experiences with loons and grebes are alike. They will almost always dive in time to save themselves if they can see the flash of the gun.

I have noticed that the flesh of the loon is very dark, almost

black in color, and the amount of blood seems excessive. The same may be said of *seals*. That is, the most thoroughly aquatic birds and mammals are characterized by exceptionally dark flesh, and an excess of blood. There is doubtless, a physiological reason for this, although I am unable to say what it is. Breeds within the Arctic Circle. (MacFarlane.)

One specimen secured, ♂ ad.

ORDER LONGPIPENNES. LONG-WINGED SWIMMERS.

FAMILY LARIDÆ. GULLS AND TERNS.

LARUS ARGENTATUS SMITHSONIANUS Coues. *American Herring Gull.* Abundant on Lake Winnipeg and all large bodies of water. Most of the specimens secured by us were shot at a lake called "Crow-Duck Lake" by the natives, which is not indicated on any map. It is about eight miles south-west of Grand Rapids, is nearly circular in shape, and perhaps fourteen miles in diameter. It empties by a rapid stream into Lake Winnipeg some ten or fifteen miles distant. We were told that both pelicans and cormorants had breeding places on an island in this lake, but found neither. Our visit to "Crow Duck Lake" was a long to be remembered experience, involving the night spent in the muskeg without any protection from mosquitoes, mentioned in a former part of this report. We found a small rookery of herring gulls on a rocky islet in the middle of the lake, and were fortunate in securing some of the downy young, which are light gray, spotted with blackish brown, a coloration harmonizing well with the rocks. Upon our approach they tried to conceal themselves among the rushes bordering the islet, and when driven out of these, took to the water, where they were easily caught by the Indians from a canoe. This gull is considered good eating by the half breeds, great quantities being killed in the fall, as I am informed in a recent letter from Mr. Russell. I have been unable to find in any work on coloration of animals, a satisfactory theory to account for the white color of the under parts of many sea birds. It has occurred to me, how-

ever, that it may be *directive*, not, however, in the usual sense of that word. These birds are constantly patrolling the water, as it were, in search of fish. The fish, when found at all, are usually in schools or shoals, being sufficient in numbers to feed many gulls. When a gull finds good fishing, it dives, exposing the pure white of the breast and under surface of the wings, which flash a signal afar to other gulls. All collectors know how soon a large number of these birds will gather when one of them has found good fishing. Thus we can see a possible utility to the species in the possession of the white under parts, this utility being, at the same time, *no disadvantage* to the individual who unconsciously gives the signal.

Breeds within the Arctic Circle. (MacFarlane.)

Six specimens secured; 2 ♂ ads., 1 ♀ ad., 1 *juv.* and 2 in the down.

LARUS DELAWARENSIS Ord. *Ring-billed Gull.* Common around the large bodies of water, such as Lake Winnipeg and Cedar Lake. They do not, however, seem to frequent the marshes and rivers to any great extent. We did not see any, so far as I remember, around Chemawawin, nor did we discover any breeding places of this gull; but from the great numbers seen near "Dog Head," at the narrowest part of Lake Winnipeg, I should judge that breeding grounds were not far distant.

Mr. Arthur Smith, one of my companions, came near losing his life in his eagerness to secure a wounded bird of that species. The gull dropped into the water near the shore, and commenced swimming away, and Mr. Smith jumped in after it, with all his clothes and a belt with forty loaded cartridges. This load proved too much to swim with, and my impetuous friend came near not getting out of the ice cold water of Lake Winnipeg.

Four specimens secured; 1 ♂, 1 ♀, 2 *juv.*

LARUS PHILADELPHIA Ord. *Bonaparte's Gull.* Rather common on the lake shore, near Grand Rapids. Immense

numbers of this species were seen near Dog Head, and a breeding place is undoubtedly not far distant. Breeds within the Arctic Circle, (MacFarlane.) and winters as far south as South America.

Two specimens secured; both males in full summer plumage.

STERNA TSCHEGRAVA Lepech. *Caspian Tern.* One specimen of this magnificent tern was shot by Mr. Smith on Crow-Duck Lake. I do not think we saw any others. The specimen secured was in high breeding colors, with the bill an intense coral red. Thompson does not record this species from Manitoba; neither does MacFarlane include it in his species nesting within the Arctic Circle.

STERNA HIRUNDO Linn. *Common Tern.* Very abundant on Cedar Lake, where I found a breeding place on a small rocky islet near the south shore. As we approached these rocks in a canoe, we saw that there was some unusual excitement among the terns, which were wheeling around in the air with fierce screams. We soon discovered that the cause of the disturbance was a couple of herring gulls, which were hovering over the water near the rocks with evil intentions, in the shape of a determination to capture some young terns, not yet able to fly, taking their first lesson in swimming. The courage with which the terns fought off the gulls, with savage thrusts and angry cries, excited the admiration of the Indians, but did not prevent them from capturing the young terns. On the rocks were eggs and young birds in every degree of development, from individuals just out of the egg, and not yet dry, to birds nearly ready to fly. There was no nest, the eggs being deposited in depressions of the rocks. The protective coloration of both eggs and young was highly efficacious. Too little attention has, in my opinion, been paid to the coloration of young birds as having been rendered protective by natural selection. It is highly improbable, for instance, that the colors of the downy young of gulls and terns represent the ancestral forms. A much more rational view, it seems to me, is that they were attained by natural selection for protective

purposes. The downy young collected on this occasion present two perfectly well marked color phases, as follows:

(a) Upper parts mottled with black and buffy in nearly equal proportions, the latter predominating on the wings, crown, and sides of head; gular space from gonys to below hinder margin of eye in the ventral line, and from the gape to below occiput, and base of upper mandible dusky; bill light, clear yellow, with a broad terminal band of dusky. Feet pale yellow.

(b) Entire dorsal surface light buffy, with little or no black showing; otherwise like (a).

These two phases are perfectly well marked in my series including five of the first and three of the second, and do *not* indicate sexual differences; neither are they characteristic of age. Three *juvs.* about ready to fly present the following coloration:

Top and sides of head colored as in downy young; back mottled with brownish tips of pearl-blue feathers; scapulars dusky; rump and entire under parts pure white, without trace of the pearl-gray of the adults; bill, upper mandible light brown, darkening to a black tip. Feet, flesh color.

This species "breeds extensively on the shores of the Arctic Sea." (MacFarlane.)

Nineteen specimens secured; 4 ♂ ad., 1 ♀ ad., 5 ♂ *juv.*, 4 downy young, 5 ?

STERNA FORSTERI Nutt. *Forster's Tern.* I saw specimens of what I took to be this tern flying over a slough near West Selkirk, Manitoba. Thompson gives it as common on Lake Winnipeg.

HYDROCHELIDON NIGRA SURINAMENSIS. (Gmel.). *Black Tern.* This species was very abundant in the immense marshes near the mouth of the Red River of the North. We encountered it again in countless numbers in the marshes around Chemawawin, where it was breeding among the reeds in the sloughs back from the river, not associating with other

terns. I did not see a single instance in which the black tern was diving for fish, as all other terns do. On the contrary, it was constantly circling around in the air in pursuit of insects, which it caught with great dexterity. Its position in flight was more like that of a gull than a tern, the bill usually being pointed out in front of the bird, rather than directly downward, as is characteristic with terns in general, especially when feeding. This latter position would be assumed when they circled with angry cries around the collectors, but not, so far as I saw, when engaged in their ordinary pursuits.

Found from Hudson's Bay to Chili. Breeds in Northern United States and northward.

Fifteen species secured; 9 ♂, 1 ♀, 5 *juv.*

ORDER STEGANOPODES. TOTIPALMATE SWIMMERS.

FAMILY PHALACROCORACIDÆ. CORMORANTS.

PHALACROCORAX DILOPHUS. (Sw. & Rich.). *Double-crested Cormorant.* Called "*Crow-Duck*" by the natives. Not seen in large numbers at any one place, but a few were always about Grand Rapids, their favorite resting place being on some rocks in the middle of the river above the fort. We were assured that they formerly bred in great numbers in Crow-Duck Lake, which we visited without seeing any considerable number of these birds. If they ever bred there, I can see no reason for their leaving, as the place is seldom visited even by the Indians, and it is unlikely that they have been seriously molested by man, although egg collectors may have invaded even this spot. The Indians seem acquainted with their breeding habits, which indicates that there are, or have recently been, rookeries not far distant. The two specimens secured were shot while perching on a tree near the portage just above the Rapids.

FAMILY PELECANIDÆ. PELICANS.

PELECANUS ERYTHRORHYNCHUS. Gmel. *White Pelican.* Common on and near Lake Winnipeg and Cross Lake. Not

seen at Chemawawin. Above Grand Rapids was a favorite resting place of these birds, a flock of about thirty being seen almost daily standing on the rocks in the middle of the river. There are said to be extensive breeding places of this pelican on Lake Winnipeg, one of the islands in the lake being called "Pelican Island."

I have never seen this species dive from any considerable height above the water, as does the brown pelican, and it seems to make greater use of its gular pouch for storing fish than does the latter species.

One specimen shot while resting on the rocks had a fish twenty inches long in its pouch. Among a large number of brown pelicans collected by me in Florida, not a single one had a fish in its pouch, and I have frequently seen them swallow fish immediately upon catching them.

One specimen of the white pelican shot at Grand Rapids had the inside of the gular pouch fairly swarming with parasites.

During the last summer, I saw the pouch put to a use which was new, to me at least. On a very hot day I was watching the pelicans in Lincoln Park, Chicago, and saw that they had the pouches considerably distended, and their mouths open, while the birds seems to be panting much as an overheated dog would. At the same time I noticed a rythmic pulsation, if I may use the word, of the pouch. By taking a position which placed one of the birds between a very bright reflection of the sun on the water and myself, I could see numerous large blood vessels, which seemed greatly distended, in the walls of the pouch. The question arose: Were not the birds using the pouch as a dog does his tongue in panting, to cool the over-heated blood? Neither pelicans nor dogs can perspire, and the birds may have been cooling themselves by a constant application of fresh air to the intensely vascular inner surface of the pouch. Both the white and brown pelicans were going through the performance above described.

Three specimens secured: all ♂; none of them, however, had the peculiar excresence on the bill.

ORDER ANSERES. LAMELLIROSTRAL SWIMMERS.

FAMILY ANATIDÆ. DUCKS, GEESE AND SWANS.

LOPHODYTES CUCULLATUS (Linn.). *Hooded Merganser.* A flock of these birds were seen resting on a sluggish creek, which enters the Saskatchewan near Chemawawin; they were all apparently females and young.

A single specimen, ♀ ad., was seen and secured on Crow-Duck Lake.

ANAS BOSCHAS Linn. *Mallard.* "*Stock duck*" of the natives. Abundant in the sloughs above Chemawawin, where they breed. The number of ducks in this region is astounding. The Indians could easily secure and salt down enough ducks in the fall to last them all winter, but, with their usual improvidence, they allow this grand source of supplies to pass southward, without any thought of the cold and hungry winter months. Among all the ducks that we secured near Chemawawin in August, there was only one adult male. The Indians say that the drakes go off by themselves to some secluded place on or near Lake Winnipeg, to moult their wing feathers, and remain away from the females until their wings are full grown. Thompson quotes the MS. of Nash as follows: "About the middle of May the females commence to set; the drakes then moult, losing their brilliant plumage; whilst undergoing this change, they gather together in small flocks of about five or six, and hide themselves in the rushes, from which it is very hard to dislodge them, even with good dogs."[1]

Breeds within the Arctic Circle. (MacFarlane).

Nine specimens secured: 8 ♀, 1 ♂.

ANAS OBSCURA Gmel. *Dusky Duck.* A duck was described to me by the natives as the "black duck," a very large species and excellent to eat, which was said to be common on the Saskatchewan between Cedar Lake and Grand Rapids. If their description was at all correct, it must have referred to the dusky duck.

[1] The Birds of Manitoba, by Ernest E. Thompson, page 476.

ANAS STREPERA Linn. *Gadwall.* Rather common, breeding along with the mallard, in the sloughs near Chemawawin. MacFarlane thinks that this species breeds within the Arctic Circle.

ANAS DISCORS Linn. *Blue-winged Teal.* Abundant at Chemawawin, especially in a slough frequented by grebes and coots. "It seems to prefer the smaller ponds, leaving the large sheets of water to the mallard and other large ducks." (Thompson.)

Six specimens secured; 5 ♀ and 1 ♂ juv.

SPATULA CLYPEATA (Linn.). *Shoveller.* Common, associated with the blue-winged teal. Breeds within the Arctic Circle. (MacFarlane.)*

Four specimens secured; all ♀.

AYTHYA AMERICANA (Eyt.). *Red-head.* Common around Chemawawin, where it was breeding in the slough along with the mallard. About twenty miles above the village there is a lake of considerable size, through which the southern branch of the Saskatchewan runs. On this lake, and the connected marshes and sloughs, countless numbers of the red-head breed. At the time of my visit, these ducks outnumbered all others. In paddling through the sloughs, small flocks of females and young would come into view at every turn. This must be the hunter's paradise in autumn or spring. The arts that the old females would exercise to decoy us away from their broods were laughable. They seemed even more expert than other ducks in hiding. I have seen them dive and swim to the edge of a patch of rushes, and then stick their heads only above the water, remaining perfectly motionless in this position until the canoe was within a paddle's length of them. They are skillful divers, and will elude even the Indians at times, after being seriously wounded.

Downy young: Above olive brown, darkening to dusky on rump and scapulars. Buffy spots arranged as follows: One on each side of rump, one on each wing, and one on each

side of back, some distance behind the wings; top of head olive brown, which color extends down to the back of neck; sides of head bright yellow buff, with a streak of brown behind the eye; sides of body a more reddish brown than the back. Below, buffy white to middle of belly, behind which the color is greyish brown. Bill slightly broader near end than at base.

Seven specimens secured; 3 ♀ and 4 downy young.

AYTHYA VALLISNERIA (Wils.). *Canvas-back.* Apparently rare. The single specimen obtained was the only one certainly seen. I am confident that this species enjoys altogether too high a reputation as a market bird. Indeed I have seen large numbers of its relatives, the red-heads, marked and sold for canvas-back. When it comes to telling the difference between the latter and half a dozen other species after they reach the table, I doubt if one person in five hundred can distinguish with any certainty between them, at least in the West, where the canvas-back does not live on *Vallisneria.*

AYTHYA COLLARIS (Donov.). *Ring-necked Duck.* Two young specimens just attaining the contour feathers on the sides and belly, I refer with some doubt to this species. The bill is suspiciously slender, wider at end than at base, but not long enough to be *A. vallisneria.* They may possibly be *A. marila nearctica.* The coloration is close to that of *A. collaris* as described by Ridgway,[1] but the brown on top of head invades the circum- and post-ocular regions, and the seven buffy spots are somewhat obscure.

GLAUCIONETTA ISLANDICA (Gmel.). *Barrow's Golden-eye.* Two immature females secured, which must be referred to this species, although the bills are considerably smaller than the descriptions of adult birds would indicate. It is exceedingly difficult to tell young birds of this genus apart, but an application of the key in Ridgway's Manual would place the birds under discussion as *G. islandica.*

Breeds within the Arctic Circle. (MacFarlane).

[1] Manual of North American Birds, page 104.

CHARITONETTA ALBEOLA (Linn.). *Buffle-head.* Rather common, according to the natives, but we only saw a few. One small flock I discovered asleep on the sluggish waters of a bayou near Grand Rapids. Three were killed, but not saved. Two downy young only a few days old were secured at Chemawawin. Coloration is as follows:

Above rich seal brown, lightening on forehead, and darkening to almost black on rump; an indistinct buffy spot behind each wing on side of back; a buffy spot in front of the eye, narrowing into a superciliary streak; a brown band running from side of mandible through eye, and joining the brown at back of head. Below brownish buffy, darker across breast, and lighter on belly; flanks rich brown, an extension of the general color of the back.

1 ♀ was killed at Chemawawin.

ERISMATURA RUBIDA (Wils.). *Ruddy Duck.* Common at Chemawawin, breeding in the sloughs. The breeding season for this duck seems to be later than for most other species, as we secured a good series of downy young, from specimens only a few days old to those almost full grown and nearly covered with contour feathers. This series is of exceptional interest, and will be described with some minuteness.

Youngest specimens: Above seal brown, rather darker on head and rump, the almost black cap extending on the sides of head, including eyes; a conspicuous very light (almost white) spot behind wings. Below white, with a very slight buffy tinge, a white streak running from bill immediately below the brown cap to occiput; below this a sharply defined brown streak, commencing under front of eye and joining brown of occiput; chin and malar region white, behind which is a broad band of rich brown but a little lighter than the back, with a pointed extension toward bill on median line below: Breast white; belly, flank, and crissum grayish white; under surface of wing buffy white.

In slightly older specimens the brown on the back becomes

lighter, that of the rump and top of the head remaining a seal brown, and the brown collar becomes lighter and less distinctly defined.

In still older specimens, which, however, are almost entirely downy, the sides and flanks are closely and regularly barred with dark brown and brownish buff. The throat and breast are gray, the collar being a yellowish brown. The stripes about the head are less clearly defined, although the white dorsal spots are still conspicuous.

In a specimen which has attained the greater part of its contour feathers, these changes in the direction of the obliteration of primitive markings have progressed still further, the white dorsal spots being almost the only remnant of the conspicuous markings described above. In this specimen the down still remains on the head, neck and interscapular region, and extends ventrally in a wedge-shaped mass, broadest anteriorly, and running to a point in the median line of the belly.

In still older, but not full fledged specimens, the white dorsal spots have finally disappeared. The development of the peculiar stiff tail feathers of this genus is well shown in the series before us. In the youngest specimens they project slightly beyond the general downy covering, and show sparsely scattered filamentous barbs, springing from a comparatively stiff shaft. These barbs bear no hooklets. In larger specimens these sparsely barbed ends project beyond the growing ends of the full webbed rectrices, a considerable length of the shafts between the sparsely barbed and fully webbed parts being devoid of barbs. In the largest of the downy specimens the tail feathers are long and well-formed, but still bear the original sparsely barbed ends on their tips. By holding these up to the light, a series of punctures are seen to mark the points where the tips will finally break off, leaving the normally developed feather.

Fourteen specimens secured; 1 ♀, 13 downy young.

CHEN HYPERBOREA (Pall.). *Lesser Snow Goose.* Exceedingly numerous during migrations, but none seen by us. The

natives know them as "*waveys*," and do not consider them as geese at all, reserving the latter name for the Canada goose.

BRANTA CANADENSIS (Linn.). *Canada Goose.* Abundant. Breeding in Cedar Lake, and also above Chemawawin on some extensive flats. The broods of immature birds take to the water when pursued, and dive with great skill and persistence. I pursued one in a canoe with two Indians, and it gave us a lively chase, finally coming up within a few feet of the canoe, when its head was blown off with a rifle, my only weapon at the time.

OLOR *sp.* (?) *Swan.* Common during migrations. I could not distinguish the species from the description of the natives.

ORDER HERODIONES. HERONS, ETC.

FAMILY ARDEIDÆ. HERONS.

BOTAURUS LENTIGINOSUS (Montag.). *American Bittern.* A single specimen seen but not secured. No other heron was seen, nor could I find that the natives had any knowledge of them. I was never more deceived than by the stake-like appearance of this bird, as it stood erect by the rushes as we paddled by, after which it flew up with its sudden "*qua-ak*," causing me to nearly overturn the canoe in my efforts to cover it with my gun.[1] On another occasion, I saw one standing in the same position, and determined not to be befooled again, I motioned to my companion, an old Indian hunter, to paddle noiselessly toward it. I noticed a grin of what I took to be satisfaction on his not particularly handsome countenance as I carefully got my bird covered, and pulled the trigger. When the smoke cleared away, the bird had

[1] "When alarmed, the bittern, instead of rising, frequently erects its head and neck and depresses its tail between its legs, until the whole body is almost vertical, and so stands perfectly still until the danger is past." (Nash) Thompson—Birds of Manitoba, page 489.

not even changed its position. *It was a stake!* and the old Indian's satisfaction was complete.

Breeds in Manitoba. (Thompson.)

ORDER PALUDICOLÆ. CRANES, RAILS, ETC.

FAMILY GRUIDÆ. CRANES.

GRUS AMERICANA (Linn.). *Whooping Crane.* Abundant around Grand Rapids during migration. The natives describe the crane dance as a well known performance.

Breeds within the Arctic Circle. (MacFarlane.)

GRUS CANADENSIS Linn. *Little Brown Crane.* Also common during migrations, according to the natives. None seen by us.

FAMILY RALLIDÆ. RAILS, COOTS, ETC.

RALLUS VIRGINIANUS Linn. *Virginia Rail.* Common around the sloughs of Chemawawin. Although several of the specimens secured by us seem to be adult, none of them agree in coloration with the normal adult, being irregularly blotched and barred below with black, rufous and white, the rufous predominating on the throat and forebreast.

So far as I have been able to ascertain, this is the most northerly point where *R. virginianus* has been known to be common. Found around the edges of a slough, where the following species was abundant.

Five specimens secured; 4 ♂, 1 ♀.

PORZANA CAROLINA (Linn.). *Sora.* Abundant at Chemawawin. Like the previous species, all specimens secured showed a very different coloration from that of the typical adult. One only, and strangely enough, this was a young bird, showed an approach to the black head and fore neck and blue-gray breast of full plumaged birds. The remaining specimens were clear olive-brown above, more profusely streaked with white than is usual. Top of head olive-brown,

with median longitudinal band of black. Below, chin brownish white; breast ochraceous brown, lightening to white on fore parts of belly; no black about the face or fore neck, nor gray on the breast. The young bird in high plumage before referred to had not achieved its wing and tail feathers. I have never heard that rails shed all their quills at nearly the same time, as do the ducks, and so am forced to regard this specimen as one having attained an adult plumage before the wings and tail are fully developed. The breast is gray with some white blotches; face in front of eyes dusky black; throat mottled with black and white; fore breast with a black patch.

Fifteen specimens secured: 5 ♂, 7 ♀, 3 (?)

FULICA AMERICANA Gmel. *American Coot.* Abundant in sloughs around Chemawawin. Only one nearly mature specimen, the rest being evidently young birds with considerable white about the face, front of neck and breast. "The migration of the coot is very singular. Late in the autumn I have seen these birds in countless numbers in the marshes at the south end of Lake Manitoba; for a few days before their going they keep up a constant chatter and row, apparently discussing the propriety of leaving. On my going out some morning after this has gone on, not a single solitary coot has been seen, except perhaps a wounded one that cannot fly." (Nash.) Thompson—Birds of Manitoba.

ORDER LIMICOLÆ. SHORE BIRDS.

FAMILY SCOLOPACIDÆ. SNIPES, SANDPIPERS, ETC.

GALLINAGO DELICATA (Ord.). *Wilson's Snipe.* Apparently rare. One specimen secured near Grand Rapids.

Breeds within the Arctic Circle. (MacFarlane.)

TRINGA MINUTILLA Vieill. *Least Sandpiper.* Rare. One specimen shot at Grand Rapids. Common during migrations. (Thompson.)

Breeding abundantly at Fort Anderson. (MacFarlane.)

TOTANUS MELANOLEUCUS (Gmel.). *Greater Yellow-Legs.* Common above Chemawawin where there are some sand flats, about which a few of these birds may usually be seen. They do not seem to be much hunted in this region, and hence are quite fearless, calmly regarding a canoe with hunters only a few yards distant. Although we secured no young specimens, they doubtless breed somewhere in this vicinity.

TOTANUS FLAVIPES (Gmel.). *Yellow-Legs.* Apparently rare. Shot on the sand flats above mentioned.

Breeds within the Arctic Circle. (MacFarlane.)

ACTITIS MACULARIA (Linn.). *Spotted Sandpiper.* The most abundant scolopacine bird in the region of Grand Rapids, where it was always to be seen running along the rocky shore of Lake Winnipeg, or "teetering" on the summit of a boulder. Breeds in that locality. A young specimen just attaining its first plumage shows no spots on the breast or abdomen, although the down has almost entirely disappeared from that region, and the olive-brown patch on the sides of breast has appeared. The wing-coverts are tipped with white. The series collected shows a great variation in the spotting of the breast, one specimen having very sparse but well defined oval spots, regularly distributed, over the lower parts, while others have the spots almost as thick as they can be planted without being extensively confluent. The younger specimens have the barring of black on the scapulars much more distinct than the others.

The efficacy of the protective coloration of shore birds is always a source of wonder to me, and if the spotted sandpiper only knew enough to keep still, it would require sharp eyes to see it on a pebbly or stony beach. On the contrary, however, many shore birds, notably this one, seem insanely bent on making themselves as conspicuous as possible, both with voice and movement, until one is almost tempted to shoot them to stop their noise, especially when listening for the notes of other birds. I suppose the "teetering" is a part of

their call, like the wag of a barking dog's tail, but nothing could make the bird more conspicuous nor more surely attract its enemies, and this must largely offset the advantage of its protective colors.

Breeds within the Arctic Circle. (MacFarlane.)

Eight specimens secured; 6 ♂, 1 ♀, 1 *juv.*

AEGIALITIS VOCIFERA (Linn.). *Killdeer.* Not common. Seen only along the shore of the lake, where the previous species was abundant. The above remarks in regard to the protective coloration being nullified by conspicuous vociferations and actions, are even more applicable to this species. Killdeers are constantly making as much noise as possible, and inviting destruction by following up the collector with their incessant clamor. They are said to warn ducks and other game birds of the approach of the hunter, a case of disinterested interference with other people's business that no collector or hunter will regard with favor.

But one specimen secured, although several were seen.

AEGIALITIS SEMIPALMATA (Bonap.). *Semipalmated Plover.* Rare. Only one specimen secured. I do not recollect seeing others.

Breeds on coast of Arctic Ocean. (MacFarlane.)

ORDER GALLINÆ. GALLINACEOUS BIRDS.

FAMILY TETRAONIDÆ. GROUSE, PARTRIDGE, ETC.

DENDRAGAPUS CANADENSIS (Linn.). *Canada Grouse.* Two specimens secured, male and female. The male is an interesting specimen, as it intergrades, apparently, with *D. franklinii*, having the characteristic white tipped tail-coverts of that species in connection with the broad orange-brown tips of the rectrices of *D. canadensis.* The following is a detailed description of this specimen:

Above, head and neck closely barred with black and rusty; back with broader bars of black and grayish brown; super-

ciliary crest scarlet; a vertical white bar on either side of the base of culmen. Tertials tipped with white, with a more or less distinct white shaft-line. Rump barred with black and gray. Upper tail-coverts grayish white, the middle pair having a slight orange-brown suffusion. Rectrices black, the lateral ones with a large oval spot, the others with a broad terminal band of orange-brown. Below black, solid on fore breast, broken by broad, quadrate white bars elsewhere. Under tail-coverts white tipped.

BONASA UMBELLUS (Linn.). *Ruffed Grouse.* While storm-bound on the south shore of Cedar Lake, my hunter shot a grouse with a rifle and brought the headless body to camp for food. Upon examining the bird, I found it an adult with the characteristic reddish brown tail of *B. umbellus.* As this feature is apparently the crucial specific test in this genus, I am forced to enter it here, although from geographical considerations I should regard it as of exceedingly doubtful occurrence in the region under discussion.

BONASA UMBELLUS TOGATA (Linn.). *Canadian Ruffed Grouse.* Abundant in the woods along the river above Grand Rapids, where the chicks were just attaining their first permanent plumage. Of the five adult specimens secured, three have the tail feathers clear ashy-gray, while two show a rusty wash over the gray. The gray of the back is distinctly marked in only two specimens. Seven young chicks killed from the same brood exhibit every gradation between *B. umbellus* and *B. umbellus togata* in the coloration of tail feathers, some being as rusty as any "pheasant" from Iowa, and others being a clear gray. In the youngest specimens there is no sign of the black ruff externally, although by pushing aside the feathers of the shoulders, the underlying black can be seen. The black feathers are at first tipped with rusty, these tips remaining until just before the bird has attained the highest plumage, when the rusty tips disappear, and the black assumes a rich metallic green iridescence.

Fifteen specimens secured.

TYMPANUCHUS AMERICANUS (Rich.). "*Prairie Hen.*" A letter just received from Mr. Frank Russell, who is now[1] collecting for our museum in that region, speaks of the "*prairie chicken*" as common around Grand Rapids. He is surely too experienced to mistake his bird, and hence I place the species on the list. I wish, in this connection, to enter a protest, on behalf of western hunters and naturalists, against calling this bird the "*prairie hen.*" "*Prairie chicken!*" it is throughout the west and north-west United States, and prairie chicken it will be so long as it is hunted, the A. O. U. check-list to the contrary notwithstanding. *Pediocætes phasianellus* goes by the name of "*sharp-tailed grouse*," and is *not* the "prairie chicken," except in the vernacular of the more ignorant hunters of the north-west.

PEDIOCÆTES PHASIANELLUS (Linn.). *Sharp-Tailed Grouse.* Abundant near Grand Rapids, especially in a dense tangle above the fort. The large series of young secured by us is interesting as illustrating the color phases between the downy stage and maturity. In the youngest specimens, still retaining the down on the head, the coloration is as follows: Top of head irregularly spotted with black and ochraceous white; throat white; feathers of back black, with white shaft-lines and dusky bars; below, each feather white, with a large dusky spot on each side near tip; rectrices with shaft-lines white, the rest of each feather being blotched with buffy and marked with zigzag black lines. Quills; inner webs dusky, outer webs with broad ochraceous blotches which are confluent along outer edge.

The next phase is characterized by the bright rufous top of head surrounding a black crown patch; sides of head, throat and fore neck bright ochraceous; auricular spot black. Feathers of back with sharp, white shaft-lines and rusty tips, otherwise mainly black. Tail feathers with broad, white shaft-line, bordered by angular blotches of black, tending to form bars which alternate with clear bay bars.

[1] October, 1892.

A third stage is characterized by having the head above, and back as before, chin and throat white; breast with round, black spots; tail feathers with terminal portion of white shaft-lines interrupted by black bars; quills of rectrices black for basal two-thirds, contrasting sharply with white central portion, which is itself bordered by a sharp longitudinal stripe of black. External tail-feathers nearly pure white.

From this stage to the adult, there is a gradual obliteration of the clear rufous top of the head by small black and ochraceous bars; the feathers of the back lose their white shaft-lines, becoming barred with black and ochraceous. The central rectrices become lengthened and linear, and all the tail feathers assume a barred pattern of dusky and ochraceous brown. The original ochraceous blotches on outer web of primaries become more restricted and sharply defined, and assume a pure white color. These birds, when young, invariably take to the trees when hard pressed.

Twenty-three specimens secured.

ORDER RAPTORES. BIRDS OF PREY.

FAMILY FALCONIDÆ. VULTURES, FALCONS, HAWKS, ETC.

CIRCUS HUDSONIUS (Linn.). *Marsh Hawk.* Abundant, especially in the great marshes near the mouth of the Red River, where dozens of these specimens were seen. Common, also, near a slough below Chemawawin, where I shot three specimens and only secured one, a female which had evidently been nesting, as its breast was almost bare of feathers.

Breeds within the Arctic Circle. (MacFarlane.)

HALIÆETUS LEUCOCEPHALUS (Linn.). *Bald Eagle.* Common in this region. One specimen, a "black eagle," was secured from an Indian hunter. Two others were taken from the nest by Messrs. Smith and Russell under circumstances involving a degree of pluck which I have seldom seen surpassed. The nest was discovered on the shore of

"Crow Duck Lake" on the occasion of the trip before alluded to, involving such hardships and torment as is seldom experienced even by old and tried collectors. We could not stop to investigate the nest at the time, but during my absence on a moose hunt, these young men determined to repeat the terrible experience of the former trip, for the sake of getting the eagles, and went alone on that sixteen mile tramp through the muskeg, cut down a tree, and secured the eagles. Considering the fact that it sometimes took an hour of the severest labor to penetrate a mile of this fearful country, and the danger of being forced to spend a night with no protection against the insect pests, this tramp amounted to genuine heroism. I must confess that I wouldn't have undertaken it for all the eagles in the Saskatchewan country, and I am no novice in the matter of roughing it, either.

Two specimens thus secured had attained their contour feathers all over, with the exception of the down about the neck and breast, which gives them a striking resemblance to vultures, a fact that suggests the possibility of the downy ruff of the condor being nothing more nor less than the persistence of an immature plumage, an "embryonic character," so to speak.

Breeds within the Arctic Circle. (MacFarlane).

FALCO COLUMBARIUS Linn. *Pigeon Hawk.* One specimen, a female, secured at Grand Rapids.

FALCO RICHARDSONII Ridgw. *Richardson's Merlin.* One specimen, male, secured at Grand Rapids.

Breeds within theArctic Circle. (MacFarlane).

FALCO SPARVERIUS Linn. *Sparrow Hawk.* Very abundant near Grand Rapids, where it subsists largely on insects, darting after them from a perch on a dead tree, just as do the flycatchers.

Six specimens secured.

FAMILY BUBONIDÆ. HORNED OWLS.

SYRNIUM NEBULOSUM (Forst.). *Barred Owl.* One specimen seen flying over our camp at Chemawawin.

NYCTEA NYCTEA (Linn.). *Snowy Owl.* One specimen seen near Crow-Duck Lake.

ORDER COCCYGES. CUCKOOS, ETC.

FAMILY ALCEDINIDÆ. KINGFISHERS.

CERYLE ALCYON. (Linn.). *Belted Kingfisher.* Common at Grand Rapids, where they were nesting in the river bank.

Breeds within the Arctic Circle. (MacFarlane).

Three specimens secured; all ♂.

ORDER PICI. WOODPECKERS, ETC.

FAMILY PICIDÆ. WOODPECKERS.

DRYOBATES VILLOSUS LEUCOMELAS. (Bodd.). *Northern Hairy Woodpecker.* Common at Grand Rapids. The lateral rectrices of the specimens secured are a pale, clear, sulphur yellow below; under tail-coverts deeply stained with brownish yellow.

Breeds within the Arctic Circle. (MacFarlane).

PICOIDES ARCTICUS (Swains.). *Arctic Three-toed Woodpecker.* Rather common at Grand Rapids. The male has a distinct buffy wash on the breast and on the under side of rectrices. The third pair of rectrices bear two white bars near tip in the male, while these feathers are entirely black in the female.

Breeds within the Arctic Circle. (MacFarlane).

Two specimens secured.

COLAPTES AURATUS (Linn.). *Flicker.* The commonest woodpecker at Grand Rapids, although none were seen at Chemawawin.

Breeds within the Arctic Circle. (MacFarlane.)

Six specimens secured; 4 ♂, 1 ♀, 1 ♂ *juv.*

ORDER MACROCHIRES. GOATSUCKERS, SWIFTS, ETC.

FAMILY CAPRIMULGIDÆ. GOATSUCKERS.

CHORDEILES VIRGINIANUS HENRYI (Cass.). *Western Night-Hawk.* Exceedingly abundant on pleasant evenings near our camp at Grand Rapids. The specimens secured are referred with some doubt to this species. They *average* much grayer on the upper surface, especially on upper wing-coverts, than *C. virginianus*, but we have one specimen of the latter from Iowa that is as gray as any collected on the Saskatchewan. The pattern of the mottling is much finer in the northern specimens, and the white at bend of wing considerably less conspicuous.

Eight specimens secured: 3 ♂, 4 ♀, 1 (?)

ORDER PASSERES. PERCHING BIRDS.

FAMILY TYRANNIDÆ. TYRANT FLYCATHERS.

TYRANNUS TYRANNUS (Linn.). *King-bird.* Common at Grand Rapids and Chemawawin. This is the only species that we found that has a concealed crest. That this crest in the flycatchers is useful as a decoy to insects has been demonstrated by the observations of Beckham and of the writer,[1] and yet a recent study of all the specimens of the family at the Smithnonian has failed to establish any generalization that will throw light upon the distribution of this concealed crest among the Tyrannidæ. Judging from the North American forms, I was led to think that the size of the birds had something to do with the matter, but some of the smallest Central American genera, *e. g. tyrannulus*, have the crest, while some of the largest are without it. It was thought, also, that it was a constant generic character, but this also fails as a theory, because several genera have some species with and some without the crests. It thus appears that these interesting structures are merely specific in character, and sometimes not even that, *e. g. Milvulus forficatus.*

[1] Proceedings U. S. National Museum Vol. V, p. 396.

The pugnacity of the king-bird is a constant source of wonder. But wherefore this pugnacity? Its food is insects, and rapidity and dexterity are valuable in securing them, but pugnacity for this purpose is about as necessary as in quail-shooting. It seems to me that the explanation may lie in the fact that the bird derives a pleasure in its skill and dexterity, and enjoys exercising them on larger and more formidable animals than its accustomed prey. In other words he is a little bully, and delights in it. Incidentally, of course, this may be a protection, but rapidity and dexterity alone would, it seems, serve to keep it out of danger. The writer is a strong believer in the intensity and variety of the emotion of birds, and is confident that they do a great many things merely for "the fun of it," in which they resemble children and other young mammals.

SAYORNIS PHŒBE (Lath.). *Phœbe.* Apparently not common. One specimen secured.

EMPIDONAX FLAVIVENTRIS. Baird. *Yellow-bellied Flycatcher.* One specimen secured.

EMPIDONAX DIFFICILIS Baird. *Baird's Flycatcher.* Common at Grand Rapids in the dead timber of the muskeg.
Three specimens secured.

EMPIDONAX MINIMUS Baird. *Least Flycatcher.* Common at Grand Rapids. The small flycatchers collected by us are somewhat difficult of identification. Indeed, I am unable to see how any one can identify them at sight while alive in the woods, and yet such expressions as "Saw least flycatcher in scrub along the river"[1] is by no means rare in reports and collectors' notes. In my opinion, notes on these small and little differentiated species are of doubtful use unless the specimens themselves are secured.

EMPIDONAX PUSILLUS TRAILLII. (Aud.). *Traill's Flycatcher.* Very common at Chemawawin, especially in the

[1] The Birds of Manitoba. Thompson, Page 562.

trees bordering a slough, where they seemed to have excellent hunting. They perched on the lowest branches and bushes, and evidently lived on the insects flying over the water. None secured at Grand Rapids, where it is replaced by *E. minimus*.

Seven specimens secured.

FAMILY CORVIDÆ. CROWS, JAYS, ETC.

CYANOCITTA CRISTATA (Linn.). *Blue Jay*. I saw, in the Post Residence near Chemawawin, a mounted specimen of this species, which was killed by the Indians and mounted by Mrs. King, the wife of the Post Master.

PERISOREUS CANADENSIS. (Linn.). *Canada Jay*. "*Whiskey Jack*." Abundant at Grand Rapids. The white on forehead and head is much more restricted than in Colorado specimens, although this may be due to immature or summer plumage. In the series of ten specimens of various ages, which we secured, the change from the uniform dusky young to the adult plumage seems to progress as follows:

The first white to appear is on the tips of the rectrices and primaries and the malar stripe; next a white band appears on the breast, and the malar stripe is continued into an ill-defined light patch on sides of neck; the neck band broadens and extends around the neck, and forward on throat and chin; the white on forehead appears and gradually extends backward. The average measurements of the specimens secured are: Length 10.9, wing 5.5, tail 6.3, tarsus 1.2. The Indians accuse this bird of warning the moose of the approach of the hunter.

Breeds within the Arctic Circle. (MacFarlane).

CORVUS CORAX SINUATUS (Wagl.). *American Raven*. The call of the raven was heard by Messrs. Smith and Russell, and we were told by Mr. McLean that a species of raven was not uncommon at Grand Rapids.

Since writing the above, a letter received from Mr. Russell informs me that he has secured two specimens of this species at Grand Rapids.

CORVUS AMERICANUS (Aud.). *American Crow.* Abundant and surprisingly tame. Young crows made themselves at home on the houses and in the door yards at Grand Rapids. The Indians do not seem inclined to molest them, and appear rather to like to have them about.

Breeds within the Arctic Circle. (MacFarlane.)

Three specimens secured.

FAMILY ICTERIDÆ. STARLINGS, BLACKBIRDS, ETC.

XANTHOCEPHALUS XANTHOCEPHALUS (Bonap.). *Yellow-headed Blackbird.* Abundant at Chemawawin, breeding in a slough. Large numbers of these birds were also seen near the mouth of the Red River of the North.

Four specimens; 1 ♂, 3 ♀.

AGELAIUS PHŒNICEUS (Linn.). *Red-winged Blackbird.* Common. An adult female from this region differs considerably in coloration from others secured at the same time. It is not streaked above, except in the possession of slight indications of streaks in the interscapular region. Below, the prevailing color is dark brown streaked with buffy white; throat a deep ochraceous buff. The bill is short and very stout.

Seven specimens secured; 3 ♂, 2 ♀, 2 ♂ *juv.*

SCOLECOPHAGUS CAROLINUS (Müll.). *Rusty Blackbird.* Common at Chemawawin.

Breeds within the Arctic Circle. (MacFarlane.)

SCOLECOPHAGUS CYANOCEPHALUS (Wagl.). *Brewer's Blackbird.* Apparently rather common, although we secured but two, both ♀.

QUISCALUS QUISCULA ÆNEUS (Ridgw.). *Bronzed Grackle.* Very abundant at Grand Rapids and Chemawawin.

Fourteen specimens secured.

FAMILY FRINGILLIDÆ. FINCHES, SPARROWS, ETC.

CARPODACUS PURPUREUS (Gmel.). *Purple Finch.* The single male secured agrees with this species in measurements, but has the bright crimson on crown which characterizes *C. cassini.*

LOXIA CURVIROSTRA MINOR (Brehm.). *American Cross-Bill.* A specimen was brought by fishermen to Mr. McLean. It was not seen by us.

SPINUS PINUS (Wilson). *Pine Siskin.* Two specimens secured at Grand Rapids; both ♀.

POOCÆTES GRAMINEUS (Gmel.). *Vesper Sparrow.* Common at Grand Rapids. Five specimens secured; all ♂.

AMMODROMUS BAIRDII (Aud.). *Baird's Sparrow.* One specimen secured the first time we went collecting at Grand Rapids. Shot on a high grassy plain between the fort and the lake.

ZONOTRICHIA ALBICOLLIS (Gmel.). *White-throated Sparrow.* One of the most abundant birds at Grand Rapids, where its cheery note was often heard in whichever direction we went. Thompson gives this bird, which he calls the "Peabody," as a migrant in Manitoba, but it breeds in great numbers near Grand Rapids.

Fourteen specimens secured, some of which are quite young birds.

SPIZELLA SOCIALIS (Wils.). *Field Sparrow.* Very abundant both at Grand Rapids and Chemawawin. At Chemawawin this species was feeding largely on the seeds of aquatic plants on the margin of the slough east of the village.

SPIZELLA PALLIDA (Swains.). *Clay-colored Sparrow.* Thiee specimens secured.

JUNCO HYEMALIS (Linn.). *Common Snow Bird.* Abundant at Grand Rapids, where it was breeding. Nests in thick bushes along the river bank opposite the fort.

Young: Above, olivaceous brown heavily streaked with black, the latter predominating on top and sides of head; secondaries black, edged with rusty brown. Below, ochraceous on breast, and white with sulphur wash on belly; legs very pale brown; bill dusky. As the birds grow older the feet become darker and the bill lighter. The youngest of these specimens are so unlike juncos in general appearance that one would hardly suspect their true identity, were it not for the white lateral tail feathers. Fourteen specimens secured.

MELOSPIZA FASCIATA (Gmel.). *Song Sparrow.* The most abundant sparrow both at Grand Rapids and Chemawawin, wherever the shrubbery was thick. The central tail feathers in all of the fourteen adult specimens secured were very narrow and pointed, almost linear, much as in the genus *Ammodromus.* This appearance is perhaps produced by the wearing away of the barbs, although why this pair of rectrices alone should be thus worn is a puzzling question.

Young much darker than adults. Breast with a buffy suffusion, and more finely streaked than in adult, these streaks not aggregated into a spot. Top of head very dark brown or dusky; no pure white anywhere; wings and tail feathers dark brown, almost black, edged with rufous. The malar stripe is the first distinctive adult marking to appear.

Twenty-six specimens secured.

FAMILY HIRUNDINIDÆ. SWALLOWS.

TACHYCINETA BICOLOR (Vieill.). *Tree Swallow.* While on a moose hunt about twenty miles above Chemawawin, I saw apparently thousands of these birds on a few dead trees standing out in the marsh. Some of these trees were so crowded by the perching swallows that there seemed literally to be no more room.

FAMILY AMPELIDÆ. WAXWINGS.

AMPELIS CEDRORUM *Cedar Waxwing.* Abundant and

nesting at Chemawawin and Grand Rapids. Nest well made of rather coarse twigs. The cedar birds were usually seen in small squads of three to six. They often frequented the limbs of dead trees, from which they swooped down after the manner of flycatchers. Out of eleven adult specimens, only three have the waxy tips to the secondaries, two of these being females and one a male. An Indian woman brought me a nest and eggs of this species, upon which a fairly mounted bird, prepared by herself, was placed. How she conceived the idea I could not discover.

FAMILY VIREONIDÆ. VIREOS.

VIREO OLIVACEUS (Linn.). *Red-eyed Vireo.* Abundant. Breeding at Chemawawin. One of the most conspicuous songsters at Grand Rapids.

VIREO SOLITARIUS (Wils.). One specimen secured.

FAMILY MNIOTILTIDÆ. WOOD WARBLERS.

MNIOTILTA VARIA (Linn.). *Black-and-White Warbler.* One specimen found dead in the woods at Grand Rapids.

HELMINTHOPHILA PEREGRINA (Wils.). *Tennessee Warbler.* Common at Grand Rapids, where it doubtless breeds.

Four specimens secured, one of which was evidently a young-of-the-year.

DENDROICA ÆSTIVA (Gmel.). *Yellow Warbler.* Common at both stations. Breeding in a thicket near Chemawawin. Nestling, a dull olivaceous brown above; below dull yellow, washed across the breast and throat with color of the back. Breeds within the Arctic Circle. (MacFarlane).

Eight specimens secured.

DENDROICA CORONATA (Linn.). *Myrtle Warbler.* Abundant at Grand Rapids and Chemawawin. Breeding in the latter place. Young with no yellow anywhere; above oliva-

ceous brown, obscurely streaked with black; below white, thickly streaked with black, with an indistinct wash of buffy across the breast. Youngest specimens almost clear olive brown above, light olive or buffy brown below; crissum yellow. At a little later stage the yellow patches on sides of breast are indicated by a brightening of the buffy brown in these regions.

Breeds within the Arctic Circle. (MacFarlane.)

Six specimens secured.

DENDROICA MACULOSA (Gmel.). *Magnolia Warbler.* Abundant at Chemawawin. Six specimens secured.

DENDROICA STRIATA (Forst.). *Black-poll Warbler.* One specimen, male, secured at Grand Rapids.

SEIURUS NOVEBORACENSIS (Gmel.). *Water Thrush.* Two specimens from Chemawawin agree more nearly with this species than with *S. noveboracensis notabilis.*

GEOTHLYPIS *sp?* The single specimen (male) secured is a striking combination in color characters of *G. macgillivrayii* and *G. philadelphia*, having the white spots on eyelids and black lores of the former, and the black chest and throat of the latter. The white spots on the eyelids are composed of about three minute perfectly white feathers.

Measurements: Length 5 inches; wing 2.50; tail 2.10; tarsus .85; thus agreeing with *G. macgillivrayii.* Mr. Ridgway, to whom I gave a verbal description of this bird, is inclined to pronounce it a hybrid. This is, perhaps, the more probable supposition; but it might possibly be a specimen of the original species from which both the present species took their origin.

The hybrid question is a most important and interesting one, and it is to be hoped that some one with abundant material at command, e. g. Mr. Ridgway himself, will attack it in earnest.

SYLVANIA PUSILLA (Wils.). *Wilson's Warbler.* Found at Grand Rapids and Chemawawin.

Three specimens secured.

SYLVANIA CANADENSIS (Linn.). *Canadian Warbler.* One specimen secured at each station.

FAMILY TROGLODYTIDÆ. WRENS, THRUSHES, ETC.

CISTOTHORUS PALUSTRIS (Wils.). *Long-billed Marsh Wren.* Three specimens of this species were secured at Chemawawin. They agree in having the tail feathers very distinctly barred, and the tail-coverts above and below with no trace of bars. This coloration is a combination of that of *C. palustris* and *C. palustris paludicola* Baird; the former having tail-coverts unbarred, and the latter showing distinct bars on the rectrices.

FAMILY PARIDÆ. NUTHATCHES and TITS.

PARUS HUDSONICUS Forst. *Hudsonian Chickadee.* Two specimens secured at Grand Rapids.

PARUS ATRICAPILLUS SEPTENTRIONALIS (Harris). *Long-tailed Chickadee.* One specimen from Grand Rapids.

FAMILY SYLVIIDÆ. KINGLETS, GNAT-CATCHERS.

REGULUS SATRAPA Licht. *Golden-crowned Kinglet.* Seen near Grand Rapids. None secured.

FAMILY TURDIDÆ. THRUSHES, ETC.

TURDUS USTULATUS SWAINSONI Cab. *Olive-backed Thrush.* One specimen secured at Grand Rapids.

TURDUS AONALASCHKÆ PALLASII Cab. *Hermit Thrush.* Abundant at Grand Rapids. The ventriloquial powers of this bird are unsurpassed in my experience. Its rich liquid warble comes from every side in turn. This is partly from

the habit the bird has of circling around the hunter, stopping in each tree long enough to beguile him into thinking the songster is at last located, and then flitting slyly to the next and repeating the performance. In addition to this, however, the voice is exceedingly difficult to locate, even when the bird remains in one spot.

Eleven specimens secured.

MERULA MIGRATORIA. (Linn.). *American Robin.* Very abundant at Grand Rapids, although none were seen at Chemawawin.

A reference to the appended tables shows that the great majority of the species secured by us are familiar migrants in Iowa and are winter residents in the southern part of North America, or in Central America. It is still more interesting to note that a majority of the species breeding within the Arctic Circle are winter residents of sub-tropical or tropical America. This implies a biennial migration of about three thousand miles on the part of a large proportion of our North American birds.

The fact of this migration is now pretty generally understood. The origin of the migratory habit is very happily and tersely explained by Dr. Leonhardt Stejneger.[1] It might be questioned, however, whether this habit is solely an instinctive one, or partly, at least, the result of a direct stimulus or suggestion afforded by external conditions coming with the return of the season of migration.

If a direct and immediate incentive or stimulus to migration can be found, a stimulus reasonably competent to start the birds and keep them moving to the end of their migratory journey, it would be more satisfactory to many minds than

[1] Standard Natural History, Vol. IV., p. 17.

"*instinct*" even if explained as a no more comprehensible "*hereditary habit.*"

Of course lack of food is recognized as the prime factor in causing migration, but we have still to answer the question: *How do the birds know when and in what direction to start on their migrations?*

According to the generally accepted theory, the journey is taken in response to an impulse which comes *from within*, an unconscious seeking for an unknown good.

According to the view held by the writer this impulse comes in the shape of a stimulus *from without* and the act is a *conscious* seeking for a more suitable clime, on the part of the adults at least, the young simply following or imitating their elders.

There is much to indicate that this stimulus comes in the form of *the wind.*

Any field ornithologist knows that in temperate North America, a warm rainy night in spring will bring a host of new bird arrivals. The wind of course is southerly on such a night.

It is an equally patent fact that a cold windy night in the fall will bring the birds south, the wind of course being northerly.

It has been claimed that birds do not migrate *with the wind.* This is a mistake, at least so far as central North America is concerned. Birds in this region certainly migrate north with a southerly wind and south with a northerly wind. The most favorable winds for migration in the spring are from the south-west or south-east, not often directly from the south. In the fall our strongest cold winds are from the north-west. In both cases the birds are favored by a "*quartering breeze,*" unquestionably the best to sail or fly by, and facilitating ærial navigation to a very considerable extent.

We can readily imagine that as food becomes scarce in northern regions in the fall, the birds become restless and uneasy, as has often been observed. A cold wind coming on,

the older birds are reminded that they have on previous years obtained comfort and food by moving southward aided by this favorable breeze. The younger birds may go south in imitation of their elders, or the "inherited habit" idea may enter in here.

I do not see that either of the above theories is necessarily exclusive of the other, but will venture the prediction that it will ultimately be found that we have altogether underrated the psychological activities of birds, and that they are conscious of the intent and result of many acts which we have been in the habit of regarding as purely instinctive.

The following table shows at a glance the more important features of the geographical distribution of the birds of the Lower Saskatchewan.

	Arctic.	Boreal.	Temperate.	Eastern.	Western.	Migrants in Iowa.	Never Occurs in Iowa.
Colymbus auritus *Linn.*	●	●		●	●	●	
Podilymbus podiceps (*Linn.*)		●	●	●	●		
Urinator imber (*Gunn.*)	●	●		●	●	●	
Larus argentatus smithsonianus *Coues*	●	●		●	●	●	
Larus delawarensis *Ord.*	●	●	●	●	●		
Larus philadelphia (*Ord.*)	●	●			●	●	
Sterna tschegrava *Lepech.*	●	●	●	●	●		
Sterna forsteri *Nutt.*		●	●	●	●		
Sterna hirundo *Linn.*	●	●	●	●			
Hydrochelidon nigra surinamensis (*Gmel.*)		●	●	●	●		
Phalacrocorax dilophus (*Sw. & Rich.*)		●	●	●			
Pelecanus erythrorhynchus *Gmel.*		●	●	●	●		
Lophodytes cucullatus (*Linn.*)		●	●	●	●		
Anas boschas *Linn.*	●	●		●	●	●	
Anas obscura *Gmel.*		●		●		●	
Anas strepera *Linn.*	●	●	●	●	●		
Anas carolinensis *Gmel.*	●	●		●	●	●	
Anas discors *Linn.*		●	●	●			
Spatula clypeata *Linn.*		●	●	●	●		
Aythya americana (*Eyt.*)		●		●	●	●	
Aythya vallisneria (*Wils.*)		●		●	●	●	
Aythya collaris (*Donov.*)		●		●	●	●	
Glaucionetta islandica (*Gmel.*)	●	●		●	●	●	
Charitonetta albeola (*Linn.*)		●		●	●	●	
Erismatura rubida *Wils.*		●		●	●	●	
Chen hyperborea (*Pall.*)	●	●		●		●	

	ARCTIC.	BOREAL.	TEMPERATE.	EASTERN.	WESTERN.	MIGRANTS IN IOWA.	NEVER OCCURS IN IOWA.
Branta canadensis (*Linn.*)	●	●		●	●	●	
Olor sp?	●					●	
Botaurus lentiginosus (*Montag.*) . . .		●	●	●	●		
Grus americana (*Linn.*)	●	●	●	●	●		
Grus canadensis (*Linn.*)	●	●	●	●	●		
Rallus virginianus *Linn.*		●	●	●	●		
Porzana carolina (*Linn.*)		●	●	●			
Fulica americana *Gmel.*		●	●	●	●		
Gallinago delicata (*Ord.*)	●	●		●	●	●	
Tringa minutilla *Vieill.*	●	●		●	●	●	
Totanus melanoleucus *Gmel.*		●		●	●	●	
Totanus flavipes (*Gmel.*)	●	●		●		●	
Actitis macularia (*Linn.*)	●	●	●	●	●		
Ægialitis vocifera (*Linn.*)		●	●	●	●		
Ægialitis semipalmata *Bonap.*	●	●		●	●	●	
Dendragapus canadensis (*Linn.*) . . .	●	●		●			●
Bonasa umbellus (*Linn.*)		●	●	●			
Bonasa umbellus togata (*Linn.*)		●		●	●		●
Pediocætes phasianellus (*Linn.*)	●	●		●	●		●
Circus hudsonius (*Linn.*)	●	●	●	●	●		
Haliæetus leucocephalus (*Linn.*) . . .	●	●	●	●	●		
Falco columbarius *Linn.*	●	●	●	●	●		
Falco richardsonii *Ridgw.*	●	●	●		●		
Falco sparverius *Linn.*	●	●	●	●	●		
Syrnium nebulosum (*Forst.*)		●	●	●			
Nyctea nyctea (*Linn.*)	●	●		●	●	●	
Ceryle alcyon (*Linn.*)	●	●	●	●	●		

	ARCTIC.	BOREAL.	TEMPERATE.	EASTERN.	WESTERN.	MIGRANTS IN IOWA.	NEVER OCCURS IN IOWA.
Dryobates villosus leucomelas (*Bodd.*) .		●		●	●		●
Picoides arcticus (*Swains.*)	●	●		●	●		●
Colaptes auratus (*Linn.*)	●	●	●	●			
Chordeiles virginianus henryi (*Cass.*) . .		●			●		●
Tyrannus tyrannus (*Linn.*)		●	●	●			
Sayornis phœbe (*Lath.*)		●	●	●			
Empidonax flaviventris *Baird.*)		●		●		●	
Empidonax difficilis *Baird.*		●	●		●		●
Empidonax pusillus trailii (*Aud.*) . . .		●	●	●			
Empidonax minimus *Baird.*		●	●	●			
Cyanocitta cristata (*Linn.*)		●	●	●			
Perisoreus canadensis (*Linn.*)	●	●		●			
Corvus corax sinuatus (*Wagl.*)	●	●	●		●		●
Corvus americanus *Aud.*	●	●	●	●	●		
Xanthocephalus xanthocephalus (*Bonap.*)		●	●		●		
Agelaius phœniceus (*Linn.*)		●	●	●	●		
Scolecophagus carolinus (*Müll.*)	●	●	●	●			
Scolecophagus cyanocephalus (*Wagl.*) .		●	●		●		●
Quiscalus quiscula æneus (*Ridgw.*) . .		●	●	●			
Carpodacus purpureus *Gmel.*.		●	●	●			
Loxia curvirostra minor (*Brehm.*) . . .	●	●	●	●			
Spinus pinus (*Wils.*)		●	●	●	●		
Poocætes gramineus (*Gmel.*)	●	●	●	●			
Ammodramus bairdii (*Aud.*)		●	●	●	●		
Zonotrichia albicollis (*Gmel.*)		●		●		●	
Spizella socialis (*Wils.*)		●		●		●	

	ARCTIC.	BOREAL.	TEMPERATE.	EASTERN.	WESTERN.	MIGRANTS IN IOWA.	NEVER OCCURS IN IOWA.
Spizella pallida (*Swains.*)		●	●		●		
Junco hyemalis (*Linn.*)	●	●		●			
Melospiza fasciata (*Gmel.*)		●	●	●			
Tachycineta bicolor (*Vieill.*)		●	●	●	●		
Ampelis cedrorum (*Vieill.*)		●	●	●	●		
Vireo olivaceus (*Linn.*)	●	●	●	●			
Vireo solitarius (*Wils.*)		●	●	●			
Mniotilta varia (*Linn.*)		●	●	●			
Helminthophila peregrina (*Wils.*) . . .		●	●	●			
Dendroica æstiva (*Gmel.*)	●	●	●	●	●		
Dendroica coronata (*Linn.*)	●	●		●	●	●	
Dendroica maculosa (*Gmel.*)		●		●		●	
Dendroica striata (*Forst.*)	●	●		●		●	
Seiurus noveboracensis (*Gmel.*)	●	●		●		●	
Geothlypis sp?		●	●	●			
Sylvania pusilla (*Wils.*)		●		●		●	
Sylvania canadensis (*Linn.*)		●		●		●	
Cistothorus palustris (*Wils.*)		●	●	●	●		
Parus atricapillus septentrionalis (*Harris.*)		●			●		●
Parus hudsonicus *Forst.*		●		●			●
Regulus satrapa *Licht.*		●		●	●	●	
Turdus ustulatus swainsonii (*Cab.*) . .		●		●	●	●	
Turdus aonalaschkæ pallasii (*Cab.*) . .		●		●		●	
Merula migratoria (*Linn.*)	●	●	●	●			
104 Species	43	101	59	91	61	32	11
Percentages	42	98	57	88	59	31	11

CLASS REPTILIA.

ORDER OPHIDIA.

EUTÆNIA SIRTALIS Linn. A single specimen with dorsal and lateral stripes very distinct, spots not evident.

CLASS BATRACHIA.[1]

ORDER SALIENTIA.

FAMILY RANIDÆ.

RANA VIRESCENS TRACHYCEPHALA Cope. One specimen, showing no marked differences from the typical form.

RANA CANTABRIGENSIS CANTABRIGENSIS Baird. Two specimens, one of which has an irregular row of dark spots on each side of the light median dorsal line.

RANA CANTABRIGENSIS EVITTATA Cope. Two specimens, differing from the preceding in the absence of the light stripe, are referred to this variety.

CLASS PISCES.

FAMILY ACIPENSERIDÆ. STURGEONS.

ACIPENSER RUBICUNDUS Le Sueur. *Lake Sturgeon.*

FAMILY CATOSTOMIDÆ. SUCKERS.

CATOSTOMUS LONGIROSTRIS Le Sueur. *Long-nosed Sucker.*

FAMILY SALMONIDÆ. SALMON.

COREGONUS CLUPEIFORMIS (Mitch.). *White-Fish,*

[1] Unless otherwise noted, all of the remaining species in this Report were identified by Mr. H. F. Wickham, of the State University of Iowa, at the request of the author. Mr. Wickham also kindly secured the identification of the insects by the gentlemen whose names appear in connection with each Order.

FAMILY ESOCIDÆ. THE PIKES.

ESOX LUCIUS L. *Jack-Fish. Pike.*

FAMILY PERCIDÆ. THE PERCHES.

STIZOSTEDIUM VITREUM (Mitch.). *Wall-Eyed Pike.*

CLASS INSECTA.

ORDER HYMENOPTERA.

The only specimens brought back were a few larvæ of Saw-Flies.

ORDER LEPIDOPTERA.

Only a few larvæ obtained.

ORDER DIPTERA.

The material in this order being alcoholic it has proved impossible to fully identify all the species. The names of such as are available for study have been kindly furnished by Prof. J. M. Aldrich, of Brookings, S. D.

FAMILY MUSCIDÆ.

CALLIPHORA near ERYTHROCEPHALA Meig.

FAMILY TABANIDÆ.

TABANUS (THERIOPLECTES) SP.

TABANUS (THERIOPLECTES) SP.

TABANUS (THERIOPLECTES) EPISTATES O. S.

FAMILY TIPULIDÆ.

TIPULA SP. One specimen.

FAMILY CULICIDÆ.

Only females obtained. The genus and species cannot be determined.

FAMILY BIBIONIDÆ.

DILOPHUS SP.

ORDER COLEOPTERA.

FAMILY CHRYSOMELIDÆ.

TRIRHABDA LUTEOCINCTA Mann. Several specimens were obtained. They differ from Californian examples in the smaller size.

ORDER TRICHOPTERA.

FAMILY PHRYGANEIDÆ.

A single specimen brought back by the expedition seemed to belong to the genus *Neuronia* but is badly damaged by immersion in alcohol.

ORDER HEMIPTERA.

The report on these insects is kindly supplied by Prof. Herbert Osborn, of Ames, Iowa.

SUB-ORDER HETEROPTERA.

FAMILY PENTATOMIDÆ.

PERILLUS EXAPTUS Say. The single specimen of this species seems to agree more perfectly with the original description by Say than any other I have seen hitherto.

FAMILY CAPSIDÆ.

HADRONEMA PULVERULENTA Uhler. I have specimens of this insect from Illinois, through Mr. C. W. Stromberg, which differ in no particular from the single specimen in this collection.

BRACHYTROPIS (?). Two specimens of Capsidæ belonging to the sub-family Miraria appear to fall in this genus and

are of a species new to me. However it would be rather unsafe to describe them from alcoholic specimens without other species for comparison.

SUB-ORDER HOMOPTERA.

FAMILY MEMBRACIDÆ.

CERESA MELANOGASTER Osborn n. sp. Greenish-yellow, frontal horns short. Body black beneath. Legs marked with black. General form of *Ceresa brevicornis* Fitch.

Head yellow in front, no conspicuous freckles, margin whitish and contrasting strongly with the black beneath. Face black beneath, narrowly margined with yellow, beak black. Pronotum with rather short blunt horns, the lateral margins of front curving out to base of horns and the space between the horns slightly convex; greenish-yellow with a paler line running from the eyes along the anterior lateral margin of pronotum to base of horn, thence along front to dorsal ridge and extending in a somewhat broken line to near the tip of the pronotal spine. Elytra immaculate, veins pale yellow, wings with brown veins. Tergum yellow. Body beneath pitchy black. Legs yellowish, the femora more or less completely banded with black, or at least with a black patch or stripe on the upper side.

This species approaches very closely in general form to *Ceresa brevicornis* Fitch, but the lateral margins of pronotal front curve outward instead of being rectilinear and the horns are shorter and more obtuse, while the deep black color of the entire under surface of the body distinguishes it from any species known to me. Compared with *bubalus* it is smaller, the pronotal horns are very much shorter and the pronotum is as a whole narrower.

Described from three alcoholic specimens, all females, collected by Mr. Frank Russell at Grand Rapids, Lake Winnipeg, N. W. T.

ORDER ORTHOPTERA.

FAMILY ACRIDIIDÆ.

MELANOPLUS BIVITTATUS Say. A single specimen of this common insect was brought from Grand Rapids, N. W. T. The determination is due to Mr. Lawrence Bruner, of Lincoln, Nebraska.

CLASS ARACHNIDA.

ORDER ARANEÆ.

FAMILY EPEIRIDÆ.

EPEIRA PATAGIATA Clerck. One example, male.

EPEIRA STRIX Hentz. Several specimens, mostly females.

EPEIRA TRIVITTATA Keys. One example, female.

TETRAGNATHA LABORIOSA Hentz. Three young specimens are doubtfully referred here.

FAMILY ATTIDÆ.

PHILÆUS MILITARIS Hentz. Several specimens, male, female and young.

ORDER ACARINA.

FAMILY TROMBIDIIDÆ.

A single specimen is referred here by Mr. Nathan Banks who has kindly furnished names of all the Arachnids.

CLASS CRUSTACEA.

FAMILY ASTACIDÆ.

CAMBARUS SP. Several specimens of a Cray-Fish were obtained at Grand Rapids.

FAMILY LIMNIADIADÆ.

ESTHERIA SP. Three pairs of the bivalve shells were obtained at Grand Rapids.

SUB-KINGDOM MOLLUSCA.

CLASS GASTEROPODA.

FAMILY RISSOIDÆ.

BITHYNELLA OBTUSA Lea.

FAMILY VALVATIDÆ.

VALVATA TRICARINATA Say.

FAMILY SUCCINIDÆ.

SUCCINEA OVALIS Gould.
SUCCINEA AVARA Say.

FAMILY LIMNÆIDÆ.

LIMNÆA STAGNALIS L.

LIMNÆA PALUSTRIS Muell.

LIMNÆA DESIDIOSA Say.

LIMNÆA CAPERATA Say.

PHYSA GYRINA Say.

PLANORBIS TRIVOLVIS VAR. MACROSTOMUS Whiteaves.

PLANORBIS BICARINATUS Say.

PLANORBIS ALBUS Muell.

PLANORBIS PARVUS Say.

SEGMENTINA ARMIGERA Say.

CLASS LAMELLIBRANCHIATA.

FAMILY CYRENIDÆ.

SPHÆRIUM SULCATUM Lam.

SPHÆRIUM STRIATINUM Lam.

[1] Identified by Mr. B. Shimek, of the State University of Iowa.

SPHÆRIUM OCCIDENTALE Prime.

SPHÆRIUM PARTUMEIUM Say.

PISIDIUM *sp. indet.*

FAMILY UNIONIDÆ.

UNIO LUTEOLUS Lam.

MARGARITANA COMPLANATA Barnes.

ANODONTA FERUSSACIANA Lea.

On page 167, Vol. II., No. 2, of this Bulletin, will be found an acknowledgment of favors rendered the expedition by various persons and corporations. The author desires, however, to make as emphatic as possible his sense of indebtedness to the officials of the Hudson's Bay Company for their unfailing courtesy and generosity to the representatives of this University.

It is proverbial that Science has found its strongest supporters in great commercial corporations. An expedition now working in the far North in the interest of this University was made possible by the liberality of Sir Donald Smith, Governor of the Hudson's Bay Company, and his associates at Winnipeg and in the Northwest Territories.[1]

C. C. NUTTING.

[1] The conception of the undertaking referred to is due very largely to the appreciation of its scientific importance on the part of Roderick Ross MacFarlane, Esq., Chief Factor at Cumberland House, who has spent over thirty years in the service of the Company within the Arctic Circle, and whose work on "Birds nesting within the Arctic Circle" is constantly referred to in the preceding pages.

This Bulletin, as the preceding, is sent free to all institutions and individuals from whom the University of Iowa receives similar publications in exchange; to other recipients the price will be thirty-five cents, about the cost of publication.

The earlier numbers of this and the first volume are no longer to be supplied.

PRICE, FIFTY CENTS.

VOL. II. NO. 4.

BULLETIN

FROM THE

LABORATORIES OF NATURAL HISTORY

OF THE

STATE UNIVERSITY OF IOWA,

PUBLISHED BY AUTHORITY OF THE REGENTS.

IOWA CITY, IOWA:
NOVEMBER, 1893.

Vol. II. No. 4.

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OF THE

State University of Iowa.

PUBLISHED

BY AUTHORITY OF THE REGENTS.

IOWA CITY, IOWA:
November, 1893.

Secretary WM. J. HADDOCK:

We take pleasure in submitting herewith Bulletin No. 4, of Volume II, from the Laboratories of Natural History, State University of Iowa.

THE EDITORS.

OBSERVATIONS ON THE DEVELOPMENT OF THE HYPOPHYSIS CEREBRI AND PROCESSUS INFUNDIBULI IN THE DOMESTIC CAT.

By FRANK S. ABY.

These observations were made and recorded in 1889. The photographs from which the accompanying illustrations were prepared were made at that time, and all the statements that are to be found in the Summary at the close of this paper were recognized and recorded then.

Partial arrangements were made for publishing these observations, but from various causes the work has been delayed. The recent attempt of embryologists to homologize throughout the Vertebrata the structures that form the subject of this paper have urged the publishing of my observations, from the belief that the facts of observation here presented may be useful to future attempts in this direction.

The matter of nomenclature is becoming a serious question to the Biologist, especially with regard to the central nervous system. The vocabulary suggested by Wilder and Gage[1] has many features to recommend it, but there are some difficulties in the way of its universal adoption. With regard to the embryological terms the recent work of Minot[2] employs a set of words radically differing from those used by Balfour and other embryologists who used the English language. Whether it is better or not, to supplant terms such as *epiblast*, *mesoblast*, and *hypoblast*, by such words as *ectoderm*, *mesoderm*,

[1] Anatomical Technology, by Wilder and Gage. A. S. Barnes & Co., New York and Chicago. 1882.

[2] Human Embryology, by C. S. Minot. William Wood & Co., New York 1892.

and *entoderm* is a question concerning which there may reasonably exist a wide difference of opinion.

In this paper the nomenclature is that of Balfour, with but few exceptions. No new terms are introduced, but an attempt is made to give a more exact meaning to certain words. This seems necessary in order to enable these observations to be used advantageously in attempts to trace homologies. These four terms are *pituitary body*, *hypophysis cerebri*, *infundibulum* and *processus infundibuli*. Throughout the literature on this subject, *pituitary body* is used synonymously with *hypophysis*, or *hypophysis cerebri*. The synonymous use of these terms is not desirable or justifiable; for the hypophysis cerebri in Mammalia does not develop into what is usually known and described by anatomists as the pituitary body. The pituitary body is the product of both hypophysis cerebri and processus infundibuli.

Equally erroneous is the statement that the infundibulum enters into the formation of the pituitary body. The infundibulum in the embryo kitten passes down on the ventral side of the hypophysis cerebri, while the process given off from the infundibulum higher up passes to the dorsal side, as may be seen in figure 6. It is this latter structure, the processus infundibuli, which, uniting with the hypophysis cerebri assists in the formation of what is known in the adult as the pituitary body.

The term *pituitary body* should be reserved for the structure which in higher Vertebrates results from the the union of the hypophysis cerebri and the processus infundibuli.

The word itself, and its application to the structure under consideration, is of some historic interest. It is from the Latin *pituita*, given thus in the Century Dictionary: [L., mucus, phlegm; prob. with loss of initial *S*, < *spuere* pp. *sputus*, spit out.] The old idea of the function of this pituitary body is still expressed when it is called the *pituitary gland*, and probably the idea will be perpetuated in the use of this word, just as old notions are preserved to us by such words as *artery* and *courage*.

HISTORICAL.

The mode of origin of the pituitary body has been an interesting problem to embryologists from the time of its discovery. Since the solution of this problem, the much more difficult one of its function or functions, and of the homologies of the two structures entering into its formation, have engaged the attention of embryologists. The very name *pituitary body*, by which these combined structures are known, is a curious vestige of an old belief, as pointed out previously.

In the Atlas of Histology, by Klein and Noble Smith,[1] Chapter XLIII is devoted to what are commonly but erroneously called Ductless Glands. The opening paragraphs are as follows:

"These are: the frontal or large lobe of the pituitary gland or hypophysis cerebri, the thyroid gland, the carotic gland of Luschka, the suprarenal body and the coccygeal gland of Luschka. These organs have the same developmental history and resemble each other in many respects. They are all derived from the hypoblast forming the wall of the fœtal alimentary canal in its earliest stage, and are therefore of epithelial origin. The hypophysis is an outgrowth of the cephalic extremity of the alimentary canal (the upper wall of the pharynx), the thyroid gland and carotic gland of its cervical part, the suprarenal body of the trunk part, and the coccygeal gland of the caudal end of the alimentary canal.

In all of them the epithelial structures, derived from the hypoblast, and the vascular connective tissue, derived from the mesoblast, form the two chief constituent elements, and in this respect they resemble other secreting glands. Unlike these latter they do not possess any special ducts to carry away the secretion, but this is probably effected by their lymphatics."

In an old edition of Foster and Balfour's Elements of Embryology[2] is a brief review of the earlier literature on the

[1] Atlas of Histology, by Klein and Noble Smith. Smith, Elder & Co., London. 1880.

[2] Elements of Embryology, by Foster and Balfour. Macmillan & Co., London. 1874. Page 91.

hypophysis cerebri. Here, as elsewhere, *pituitary body* is used for *hyphophysis cerebri.* As a thorough knowledge of the opinions of previous observers is necessary to an understanding of this paper, it is thought best to introduce the entire review.

The development of the pituitary body or hypophysis cerebri has been the subject of considerable controversy amongst embryologists. Von Baer (loc. cit.) and Smidt (*Zeitschrift fuer Wiss. Zoologie*, 1862, B. XI, p. 43) believed that the base of the fore-brain, or vesicle of the third ventricle, became produced into a downward process, the "infundibulum," which subsequently became expanded at its termination to form the pituitary body.

Rathke (*Archiv fuer Anatomie und Physiologie*, 1833, Bd. v.) states that very early a diverticulum is produced from the upper end of the alimentary canal, which passes backwards and meets the process of the brain called the infundibulum. This diverticulum subsequently loses all connection with the epithelium of the digestive canal, and, uniting with the infundibulum, forms the pituitary body.

Dursy (*Entwicklungsgeschichte des Kopfes*, Tübingen, 1869) states that both the end of the notochord and the epithelium of the alimentary canal take part in the formation of the pituitary body. The apparent diverticulum of the alimentary canal is not so much a true diverticulum, as a part of the alimentary canal constricted off from the remainder by the cranial flexure.

Reichert (*Entwicklungsleben im Wirbelthierreich*, Berlin, 1840) states that the pituitary body is formed from the remains of the front end of notochord.

Subsequently however (*Der Bau des menschlichen Gehirns*) he supposed that it was formed from the pia mater.

Rathke also subsequently (*Entwicklungsgeschichte der Wirbelthiere*, Leipzig, 1861) gave up his former view, and believed that the diverticulum of the alimentary canal disappeared, but that the pituitary body was formed from the mesoblast in front of the clinoid process.

Wilhelm Müller (*Ueber die Entwicklung und Bau der Hypophysis und des Processus infundibuli cerebri*, *Jenaische Zeitschrift*, Bd. VI. 1871) has recently written an elaborate memoir on the development and anatomy of the pituitary body and infundibulum in all the orders of Vertebrates, of which the following is an abstract.

In order to understand the formation of the diverticulum from the alimentary canal which forms the pituitary body, we must remember that at first the hypoblast of the throat closely underlies the notochord, and beyond the end of the notochord is almost in contact with the base of the vesicle of the third ventricle. When the cranial flexure occurs, which it will be remembered takes place about an axis coinciding with the end of the notochord, the hypoblast, which closely underlies the base of the brain, becomes at the same time bent; and as the angle of the flexure becomes an acute angle, a wedge-shaped space lined by hypoblast is as it were constricted off from the alimentary canal. In this way there is formed a diverticulum of hypoblast which passes forwards from the alimentary canal to the base of the fore-brain—a diverticulum not produced by a forward growth from the alimentary canal, but solely due to the cranial flexure constricting off a wedge-shaped portion of the alimentary canal. This we may call the pituitary diverticulum. When the cranial flexure commences the end of the notochord becomes bent downward, and, ending in a somewhat enlarged extremity, comes in contact with the termination of the pituitary diverticulum. The mesoblast around and at the front of the end of the notochord increases and grows up, in front of the notochord and behind the vesicle of the third ventricle, to form the posterior clinoid process. The base of the vesicle of the third ventricle at the same time grows downwards towards the pituitary diverticulum and forms what is known as the infundibulum. This state of things may be observed on the third day. On the fourth day the mesoblast tissue around the notochord increases in quantity, and the end of the notochord, though still bent downwards, recedes a little from the termination of the pituitary diverticulum, which is still a triangular space with a wide opening into the alimentary canal.

On the fifth day, the opening of the pituitary diverticulum into the alimentary canal has become narrowed, and around the whole diverticulum a formation of mesoblast-cells has commenced. Behind it the clinoid process has become cartilaginous, while to the side and in front it is enclosed by the trabeculæ. At this stage, in fact, we have a diverticulum from the alimentary canal passing through the base of skull to the infundibulum. The end of the notochord has at this stage become atrophied, so that it is separated by a considerable interval from the pituitary body.

On the seventh day the mesoblast around the pituitary diverticulum has grown into a complete investment of spindle-shaped cells, and the communication between the cavity of the diverticulum and that of the throat has become still narrower. The diverticulum is all but converted into a vesicle, and its hypoblast walls have commenced to send out into the mesoblastic investment solid processes, which form the first commencement of the true pituitary body. The infundibulum now appears as a narrow process from the base of the vesicle of the third ventricle, which approaches, but does not unite with the pituitary vesicle. The latter lies in the space between the basi- and the pre-sphenoid, and is completely surrounded by a ring of cartilage. The mesoblast-cells immediately around it do not, however, exhibit any signs of becoming cartilaginous.

By the tenth day the opening of the pituitary vesicle into the throat becomes almost obliterated, and the lumen of the vesicle itself very much diminished. The body itself consists of anastomosing cords of hypoblast-cells, the mesoblast between which has already commenced to become vascular. The cords or masses of hypoblast cells are surrounded by a delicate membrana propria, and a few of them possess a small lumen. The infundibulum has increased in length.

On the twelfth day the communication between the pituitary vesicle and the throat is entirely obliterated, but a solid cord of cells still connects the two. The vessels of the pia mater of the vesicle of the third ventricle have become connected with the pituitary body and the infundibulum has grown down along its posterior border.

In the later stages, all connection is lost between the pituitary body and the throat, and the former becomes connected with the elongated *processus infundibuli.*

Such is Wilhelm Müller's account. Goette, however, (*Archiv. Micr. Anat.* IX. p. 397) has recently given reasons for thinking that the pituitary diverticulum arises not from the closed fore-gut, lined with hypoblast, but from the buccal cavity lined with epiblast. He states that in its earlier stages it may be seen to start on the oral side of the partition, which for some time divides the secondarily formed buccal cavity from the primarily formed foregut, and therefore, belonging to the former, cannot be regarded as the natural anterior termination of the latter.

Another view is presented by Balfour.[1] "The pituitary body is in fact an organ derived from the epiblast of the stomodæum. This fact has been demonstrated for Mammalia, Aves, Amphibia, and Elasmobranchi, and may be accepted as holding good for all the Craniota."

In Gray's Anatomy[2] we find a very curious statement of the development of the pituitary body. A footnote on page 120, presumably by Prof. John A. Ryder, gives a much clearer and more exact account. "The epiblast of the back part of the roof of the oral invagination, where a hollow, saccular portion of the oral epiblast is constricted off and fuses with the median infundibular process of the floor of the brain, is developed into the pituitary body or hypophysis. The fusion of the infundibulum with the involution from the epiblast of the upper and posterior part of the oral cavity leads to the formation of the pituitary body or hypophysis. This, therefore, is entirely of epiblastic origin, and its relations indi-

[1] Comparative Embryology, by F. M. Balfour. Macmillan & Co., London 1880. Vol. II., page 358.

[2] Gray's Anatomy. Lea Brothers & Co., Philadelphia. 1887. Page 119.

cate that at one time the oral cavity and the brain may have been more intimately connected than at present."

In a recent work on Embryology[1] this sentence occurs: "The pituitary body arises in most Vertebrates as a tubular invagination of the roof of the mouth (stomodæum) approaching the infundibulum." In Minot's Human Embryology[2] we find the following: "The hypophysis cerebri, Rathke's pocket or pituitary body (*Hirnanhang*) is a structure of very problematical significance, which has been much studied and speculated upon by embryologists. It arises in all Vertebrates as an evagination of the ectoderm near the dorsal border of the oral plate, but is separated from the plate by a fold of the ectoderm." Again, on page 574, we find,—"The infundibulum also contributes to the production of the adult hypophysis of mammals, although in lower Vertebrates it persists as an integral portion of the brain, and is differentiated into ganglionic tissue."

But on page 687 he says, under the head of Infundibulum,—"In rabbit embryos of 12–16 mm. and in human embryos of five weeks there is found developing a small cylindrical outgrowth of the brain, which is known as the *processus infundibuli*. The outgrowth takes place in the median line immediately in front of the tuber cinereum and behind the optic chiasma. It very soon comes in contact with the hypophysal outgrowth of the mouth, and is ultimately transformed into the posterior lobe of the pituitary body as already described." This is the nearest approach to the exact use of terms that I have found in the literature bearing on this point.

Arranging these various opinions in order, we find that the following ideas have prevailed with regard to the region under discussion.

[1] An Introduction to the Study of Embryology, by A. C. Haddon. P. Blakiston, Son & Co., Philadelphia. 1889. p. 110.

[2] Human Embryology, by C. S. Minot. William Wood & Co., New York. 1892. p. 571.

1. The terms *pituitary body* and *hypophysis*, or *hypophysis cerebri*, are used interchangeably.

Elements of Embryology, Foster and Balfour, 1889, p. 119.

Introduction to the Study of Embryology, Haddon, 1889, p. 110.

Anatomical Technology, Wilder & Gage, 1882, p. 480.

Comparative Embryology, Balfour, 1889, Vol. II, p. 358.

Gray's Anatomy, 1887, p. 120.

Human Embryology, Minot, 1892, p. 571.

Quain's Anatomy, 1890, p. 68.

2. The expanded termination of the infundibulum forms the pituitary body.

Von Baer and Smidt, *Zeitschrift fuer Zoologie*, 1862, B. XI, p. 43. (Original not in hand.)

3. The end of the notochord and the epithelium of the alimentary canal take part in the formation of the pituitary body.

Dursy, *Entwicklungsgeschichte des Kopfes*, Tübingen, 1869. (Original not in hand.)

4. The hypophysis cerebri is developed from the entoderm of the alimentary tract.

Rathke, *Archiv. fuer Anatomie und Physiologie*, 1838, Bd. V. (Original not in hand.)

Wilhelm Müller, *Ueber die Entwicklung und Bau der Hypophysis und des Processus infundibuli cerebri. Jenaische Zeitschrift*, Bd. VI, 1871. (Original not in hand.)

Atlas of Histology, Klein and Noble Smith, 1880, p. 431.

5. The pituitary body is formed from the remains of the front end of the notochord.

Reichert, *Entwicklungsleben im Wirbelthierreich.* Berlin, 1840. (Original not in hand.)

6. The pituitary body is formed from the pia mater.

Reichert, *Der Bau des menschlichen Gehirns.* (Original not in hand.)

7. The diverticulum of the alimentary canal disappears, but the pituitary body is formed from the mesoblast in front of the clinoid process.

Rathke, *Entwichlungsgeschichte der Wirbelthiere*, Leipzig, 1861. (Original not in hand.)

8. The formation of the hypophysis is mechanical, due to the cranial flexure constricting off a wedge-shaped portion of the alimentary canal.

Wilhelm Müeller, *Jenische Zeitschrift*, Bd.VI, 1871. (Original not in hand.)

9. The hypophysis arises not from the closed foregut, lined with hypoblast, but from the buccal cavity lined with epiblast.

Goette, *Archiv. Micr. Anat.*, IX, p. 397. (Original not in hand.)

Comparative Embryology, Balfour, 1880, Vol. II, p. 358.
Human Embryology, Minot, 1892, p. 571.
Gray's Anatomy, 1887, p. 120.
Introduction to Study of Embryology, Haddon, 1889, p. 110.
Elements of Embryology, Foster and Balfour, 1889, p. 119.
Quain's Anatomy, 1890, pp. 68 and 100.

Thus each of the three layers of the blastoderm has been described as forming the hypophysis cerebri. The end of the notochord, and even the pia mater, has been thought to give rise to this structure. What may be called the mechanical theory at one time prevailed, and is not entirely abandoned even now. (Human Embryology, Minot, 1892, page 574.)

METHODS.

The technique employed in 1889 during these investigations would now be considered somewhat antiquated, but the results compare favorably with those obtained by more refined methods.

The embryos were hardened in increasing strengths of

alcohol, 50%, 70%, 90%, and had been in ordinary commercial alcohol several years when they came into my possession. No especial pains had been taken to fix or harden them, but the entire uterus, without being opened, had been in each case placed in alcohol.

The uterus was opened, and the embryos, still within the amnion, were taken out and placed in equal parts of sulphuric ether and 95 per cent. alcohol for several days. They were then transferred to a thin solution of Schering's celloidin in equal parts of sulphuric ether and 95 per cent. alcohol, where they remained for several days. The embryos were then transferred to a thick solution of celloidin, prepared as before. After several days of this treatment, the embryos were imbedded on cork in the usual manner, and the cork placed in 50 per cent. alcohol.

The embryos were allowed to remain in the several solutions mentioned much longer than is usually deemed necessary, in order to insure a thorough impregnation of the embryo by the imbedding material.

After being thus imbedded, the embryos were sectioned in a large Bausch & Lomb microtome, the sections being made $\frac{1}{1000}$ of an inch thick. The sections were then stained in Grenacher's hæmatoxylin.

After the sections had been stained, they were cleared with oil of bergamot, and mounted in Canada balsam, each section on an ordinary 1x3 slide. Care was taken to place them in the same relative position. After the entire number of sections from one embryo had been mounted, the slides were carefully arranged in serial order, labeled, and the labels numbered serially.

This method necessitated the expenditure of a vast amount of time, which might have been avoided by using any one of the various methods of serial sectioning. Moreover, the hæmatoxylin readily stains celloidin, and it was impossible to remove the stained celloidin from the sections by the use of oil of cloves, and still retain the cells in their relative positions.

The photographs were made with Bausch & Lomb Student objectives, in an Atwood camera. Ordinary 4 x 5 inch dry plates, made in Iowa City, were used. They were developed by the usual ferrous oxalate developer.

OBSERVATIONS.

The first studies were made on an embryo about five millimeters in length. A series of longitudinal sections was prepared in the manner described. Figure 1 is from a section very near the median plane of this embryo.

At this stage the embryo of the cat does not correspond very closely to any particular hour or day in the development of the chick. The circulatory system resembles in some respects that of a chick of the fourth day, the heart being a curiously twisted tube, five visceral arches being present. The first aortic arch is broken; the second almost obliterated; the third and fourth quite large and conspicuous; but the fifth has not yet appeared, although the fourth visceral cleft is present.

The nervous system is somewhat like that of a chick of the second or third day, the three primary cerebral vesicles being present, the cranial flexure quite pronounced, and the cephalic end of the embryo having much the appearance of a retort.

In this embryo the primitive ocular vesicles have just made their appearance, and the primitive otic vesicles are also forming; but nothing has been observed that would indicate that the vesicles of the cerebral hemispheres are begun.

Figure 2 gives an enlarged view of the cephalic extremity of the section from which figure 1 was taken. The mesoblastic axis in this region is covered by the epiblast lining the cœliæ of the encephalon. Most of the mesoblastic cells are branched, far apart, each with a large nucleus and a conspicuous nucleolus. The cells forming the long projection between the anterior and posterior cerebral vesicles are arranged in curves, as if they had been compelled to arrange themselves thus by the flexure of the cephalic end about this

axis of mesoblastic cells. Blood channels, containing nucleated blood cells, are seen lying in this mass of branched cells.

Upon the dorsal surface of this mesoblastic axis are five prolongations, reaching almost to the cœlia of the posterior cerebral vesicle. Between these prolongations the epiblast is arranged in pockets. Upon the ventral side of the mesoblastic axis is a projection, containing a nest of mesoblastic cells (N) which will be described later. This projection (N) marks the position of the oral plate, or septum which, previous to this, separated the stomodæum from the mesenteron.

On the pharyngeal side of the nest just described is a sinus known as Seessel's pocket (S. P). On the oral side of the nest is another pocket, which is the earliest indication of the hypophysis cerebri (H. C). Projecting from the cœlia of the middle cerebral vesicle towards the hypophysis cerebri and almost touching its apex is a conical space, the infundibulum, (I). In figure 2 it appears to be formed by the proliferation of cells on its ventral side, but a study of other sections in this series demonstrates that these epiblastic cells are a portion of the constriction between the anterior and middle cerebral vesicles.

From the infundibulum another broad shallow sinus is given off, which pushes into the mesoblastic axis. This is the earliest indication of the processus infundibuli (P. I).

Figure 3 is from another section of the same embryo. It shows the region of the constriction between the posterior and middle cerebral vesicles, and also indicates the line of boundary between the middle and anterior cerebral vesicles. The section was not from the median longitudinal plane, and for this reason the structures under consideration in this paper are not clearly shown.

Figure 4 is an enlarged view of the region under consideration, taken from another section in the same series. Just above Seessel's pocket, in the mesoblastic axis, is a mass of rounded cells closely aggregated, and enclosed by a thin membrane (Not). This mass is the cephalic extremity of the

notochord. The notochord in this embryo is not a straight rod, but is somewhat undulating, and for this reason but a small portion appears in this section. The cells of the notochord are usually spherical, but many are irregular, owing to mutual pressure. Many of them contain two nuclei.

Lying on the ventral side of the notochord, and forming the prominence between the Seessel's pocket and the hypophysis cerebri, is the peculiar nest of mesoblastic cells to which reference has been made. The cells forming this nest are nucleated, and are not crowded, although they are not so far apart as the branched mesoblastic cells. This nest of cells very strongly resembles an epithelioma nest. From the appearance of the branched mesoblastic cells immediately surrounding this mass, it seems that the cells forming the nest have been proliferating quite rapidly. The formation of Seessel's pocket and apparently the initiatory step in the formation of the hypophysis cerebri are due to the growth of this nest of cells. The next section to the one from which figure 4 was taken shows very distinctly a connection between the notochord and this nest of cells.

The epithelium lining the posterior pharynx consists of a single layer of cells. As the epithelium passes up to line Seessel's pocket it becomes thickened, and as it is reflected over the nest it ceases to be simple and becomes several cells in thickness. In the apex of the invagination for the hypophysis cerebri the epithelium is thickest.

Nothing has been found in any of my sections indicating the remains of the oral plate, or the point of juncture of the hypoblast and epiblast; but from previous observations (Minot, Human Embryology, figures 107 and 170) there seems little room for doubting that the nest (N) indicates the position of the dorsal attachment of the oral plate.

In figure 2 the infundibulum appears as a long finger-like process of the middle cerebral vesicle. Figure 4 shows the infundibulum as a broad sinus (I). At the upper end of the main sinus is another sinus, which, from the arrangement of

the mesoblastic cells of the mesoblastic axis, seems to be invading the mesoblast. This is the processus infundibuli (P. I).

The epiblastic cells of the cœliæ of the encephalon are not branched, are crowded closely together, and have taken a deeper stain than the mesoblastic cells. The epiblastic lining of the processus infundibuli is many cells in thickness, the cells are columnar, with large oval nuclei and with nucleoli. The epiblastic lining decreases as it approaches the lining of the stomodæum. At the very apex of the hypophysis cerebri, the two epiblastic layers of the middle cerebral vesicle and the stomodæum come in close contact, no mesoblastic cells intervening. For some distance these two layers lie side by side.

The second series of observations was made on sections of an embryo about seventeen millimeters in length. At this stage a number of important changes have taken place; but, as in the five millimeter embryo, when compared to the embryo chick, the nervous system and sense organs are not developed in proportion to the other organs. The cerebral hemispheres are formed, the eyes in many respects resemble those of a chick of the fourth day, the internal ears are well developed, the nasal pits are mere invaginations of the epiblast, somewhat like those of a chick of the third or fourth day.

From figure 5 it will be seen that the cœliæ of the encephalon are continuous, one with another; and that the cœliæ of the anterior cerebral vesicle is prolonged downward, forming a long funnel-shaped cavity, the infundibulum (I). The apex of the infundibulum comes in contact with a flask-shaped body, the hypophysis cerebri (H. C). Resting upon the base of the flask-shaped hypophysis cerebri is an irregular elongated body, the processus infundibuli (P. I).

Figure 6 is an enlarged view of the same section from which figure 5 was taken. The hypophysis cerebri is here a large flask, the walls being formed of epithelium of considerable thickness, which is continued as the neck of the flask

down toward the pharynx. The neck of the flask has separated from the epithelium lining the pharynx, owing to the separation of this lining from the mesoblast. Within the lumen of the flask is a mass of structureless matter, without evidence of nuclei. The hæmatoxylin has stained this to some extent, one patch taking rather a deep stain. The neck and the lower portion of the lumen in this flask contain many cells, so that the open communication which previously existed between the cavity of the flask and the pharynx is now obliterated.

Surrounding the hypophysis cerebri is a structureless membrane, which is quite conspicuous between the flask and the infundibulum, and also between the flask and the processus infundibuli. The mesoblastic cells are crowded back by the growth of the hypophysis cerebri.

The peculiar nest of mesoblastic cells so clearly seen in figure 4, has entirely disappeared in this embryo, and with it all traces of Seessel's pocket.

Resting on the flattened side of the hypophysis cerebri, and separated from it by a thin membrane, is the layer of cells which forms the boundary of the infundibulum. The membrane which separates these two epiblastic layers is probably derived from the mesoblast, but beyond this the two epiblastic layers are in contact. In figure 4 these two layers are in actual contact, no membrane intervening.

Above the hypophysis cerebri, and resting on its base, is an elongated body, the processus infundibuli (P. I). This is also separated from the hypophysis cerebri by the membrane previously mentioned. The processus infundibuli has advanced into the mesoblast until it approaches the nervous lining of the posterior cerebral vesicle. From all that can be seen in figure 6, the processus infundibuli is separated from the infundibulum, but this appearance is due to the fact that the section did not lie in the median plane.

Figures 7 and 8 are taken from the same embryo as that from which figures 5 and 6 were taken. Figure 7 shows the communication between the cœliæ of the anterior cerebral

vesicle and the cœliæ of the cerebral hemispheres. Figure 8 shows the walls of the processus infundibuli in connection with the walls of the infundibulum. The walls of the processus infundibuli resemble those of the hypophysis cerebri.

The lumen of the processus infundibuli is best shown in figure 6. It contains the same kind of structureless matter as the lumen of the hypophysis cerebri. It is probable that this structureless matter is of the nature of a secretion, and its behavior with hæmatoxylin leads to the impression that it is of the nature of mucous, or *pituita*.

SUMMARY.

In this paper attention is called to the following points:—

1. The term *pituitary body* is not synonymous with *hypophysis*, or *hypophysis cerebri*.

2. The term *infundibulum* should not be used for *processus infundibuli*.

3. The epithelium lining what is known as Seessel's pocket is but a single cell in thickness.

4. The epithelium lining the first appearance of the hypophysis cerebri is several cells in thickness.

5. The projection between Seessel's pocket and the hypophysis cerebri is formed by a proliferation of mesoblastic cells forming a nest, and is not necessarily the remains of the oral plate, although it indicates the position of the oral plate.

6. The cephalic extremity of the notochord is in close connection with this nest, and does not approach the hypophysis cerebri.

7. The epiblast lining the encephalon, and the epiblast lining the stomodæum lie in close contact in the region of the hypophysis cerebri.

8. The hypophysis cerebri is developed from epithelium on the cephalic side of the oral plate, hence is of epiblastic origin.

9. The processus infundibuli is also of epiblastic origin.

10. The hypophysis cerebri is the direct result of cell proliferation, and is not a mechanical constriction.

11. The processus infundibuli is also the direct result of cell proliferation.

12. The further development and union of the hypophysis cerebri and processus infundibuli form the structure known in adult Mammalia as the pituitary body; the hypophysis cerebri developing into the anterior lobe, the processus infundibuli developing into the posterior lobe, both being assisted by the proliferation of cells from the mesoblast.

Histological Laboratory,
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March, 1893.

REPORT ON THE MICROSCOPIC EXAMINATION OF BLOOD FROM A PATIENT SUFFERING FROM SPLENIC MYELOGENOUS LEUKÆMIA.

By FRANK S. ABY.

E. O. C., age forty-one, was admitted to the Hospital of the State University of Iowa, March 4th, 1893. An examination showed that the patient was suffering from splenic myelogenous leukæmia. A microscopic investigation of the blood was instituted by the writer, the results of which are embodied in the following report.

NORMAL HUMAN BLOOD.

Before proceeding to the report proper, a brief preliminary description of the microscopic characters of normal blood that are used for clinical purposes, will be useful. At least three varieties of corpuscles are found,—coloured, leucocytes, and blood plaques.

COLOURED CORPUSCLES.

Size.—The average size is usually taken as about 8μ (about $\frac{1}{3200}$ inch). In Heitzmann's Microscopical Morphology of the Animal Body,[1] we find the following: "More recently he (Richardson) measured corpuscles of individuals of fourteen different nations, one hundred of each. Of the 1,400 corpuscles measured, the average was $\frac{1}{3224}$ (.007878 mm.), the maximum $\frac{1}{2747}$, the minimum $\frac{1}{4000}$ of an inch; 1158, or 83 per cent., measured between $\frac{1}{3500}$ and $\frac{1}{3000}$ of an inch in diameter, and consequently under a power of two hundred would appear about the same magnitude; the total number of cor-

[1] Microscopical Morphology of the Animal Body in Health and Disease, by C. Heitzmann. J. H. Vail & Co., New York. 1883. p. 77.

puscles of minimum measure was only six, or less than one-half of one per cent; and the total number which measured the maximum was ten, or less than one per cent."

As the result of a number of measurements made by myself, I take as the average size of coloured corpuscles 8μ, or about $\frac{1}{3200}$ of an inch.

Number.—From a number of estimates made by the writer, the average number of coloured corpuscles in each cubic millimeter of blood from a healthy male somewhat exceeds five millions. My enumerations were made with the Thoma hæmacytometer, made by Reichert, and with another of the same kind made by Zeiss, as described by Limbeck.[1]

Shape.—As they exist in the vessels, each coloured corpuscle is a biconcave disc, with smooth circular outline. After being drawn for a few minutes, many become crenated. The coloured corpuscles of some individuals become crenated immediately on leaving the vessels, no matter how rapidly the blood is brought between the cover and the slide. Usually this change takes place only after several minutes.

Rouleaux.—When healthy human blood is placed between a slide and cover glass properly, usually the coloured corpuscles will tend to adhere to each other by their concave sides, forming rolls very much like piles of coin. To these rolls the term rouleaux is applied. Sometimes in blood that, aside from this, appears to be normal, the coloured corpuscles do not form rouleaux.

Hæmoglobin.— Although not a microscopic character, for clinical purposes an estimation of hæmoglobin should accompany every enumeration of coloured corpuscles. The instrument used by the writer in these observations is the ordinary Fleischl hæmoglobinometer, as described by Limbeck on page 17 of the work cited. This instrument is direct-reading, and the standard of normal blood is 100 per cent.

[1] Grundriss einer Klinischen Pathologie des Blutes, von Limbeck. Gustav Fischer, Jena. 1892. p. 28.

LEUCOCYTES.

Varieties.— In normal human blood, Ehrlich recognizes five varieties of leucocytes. As quoted by Osler[1] they are as follows: (Quotations from Osler slightly modified.)

1. Lymphocytes. Small cells about the size of a red blood-corpuscle, and probably derived from the lymphatic glands, which leave a single large, round, deeply staining nucleus, surrounded by a narrow rim of non-granular protoplasm.

2. Mononuclear. Cells several times as large as the red blood-corpuscle, with an oval or elliptical nucleus and a relatively larger amount of ungranulated protoplasm.

3. Transitional. Cells which resemble the last variety, but have indentations and irregularities in the nucleus.

4. Polynuclear. These are about the same size or a little smaller than the last variety. The nucleus is a long, deeply staining body which is bent and twisted on itself into irregular shapes. The protoplasm of these cells is filled with granules, which are stained, not by acid or basic colouring matters alone, but only by a combined fluid. The granules are therefore termed neutrophilic, and the name "neutrophiles" is given to these cells.

5. Eosinophiles. Cells about the same size as the last, but containing large, highly refractile, fat-like granules, which have an affinity for acid colouring matters. On account of their affinity for eosin, Ehrlich terms them *eosinophiles*.

In normal blood these cells occur in definite proportion to each other.

Lymphocytes, ...	15 to 30 per cent.
Mononuclear, ...	6 per cent.
Transitional, ...	6 per cent.
Polynuclear, ...	65 to 80 per cent.
Eosinophiles, ...	2 to 4 per cent.

Limbeck[1] gives but four varieties.

[1] Principles and Practice of Medicine, by William Osler. D. Appleton & Co., New York. 1892. p. 699.

Die im menschlichen Blute kreisenden weissen Blutkoerperchen werden in morphologischer Hinsicht meist in folgende Formen getrennt (vgl. die farbige Tafel):

1. Kleine Lymphocythen; an Groesse den rothen Blutkoerperchen ziemlich gleichkommend, besitzen sie meist einen grossen sich mit Anilinfarben intensiv faerbenden Kern, um welchen das Protoplasma einen schmalen Saum bildet.

2. Grosse Lymphocythen; ihr Durchmesser ist durchschnittlich doppelt so gross, als der der kleinen, ihr Kern relativ etwas kleiner, ihr Protoplasmakoerper entsprechend groesser. Beide Formen stammen nach Virchow aus den Lymphdruesen und soll 1. der Vorlaeufer von 2. sein.

3. Die sogenannte mononucleaere Uebergangsform. Der Kern dieser Zellen zeigt bereits eine mehr oder minder ausgesprochene Einbuchtung, und ihr Koerper schon die ersten Zeichen der sogenannten neutrophilen Koernung (s. u.).

4. Die polynucleaeren Leukocythen. Dieselben sollen eine Entwicklungsstufe von 3) darstellen; sie besitzen meist mehrere oder einen vielfach zerkluefteten Kern, sind meist groesser als die rothen Blutkoerperchen und machen nach Ehrlich ca. 70% der weissen Elemente des normalen menschlichen Blutes aus.

Ein zweites Eintheilungsprincip der im Blute vorfindlichen weissen Blutzellen ist in der von Ehrlich entdeckten differentiellen Faerbung derselben mit Anilinfarbstoffen gegeben.

Ehrlich unterscheidet 1. die α- oder eosinophile Granulation, das heisst weisse Blutzellen, deren Zellleib durch eine relativ grobe Koernung ausgezeichnet ist (grobgranulirte Zellen M. Schultze's), welch letztere aus eimen Gemisch saurer, basischer und neutraler Anilinfarben (im Sinne Ehrlich's) die saueren aufnimmt. Sie besitzen meist einen grossen, mitunter auch zwei, seltener drei Kerne. Sie stammen bei Saeugern vorwiegend aus dem Knochenmark.

2. Die β-Granulation, weisse Blutkoerperchen, deren Zellleib eine feine Koernung besitzt. Diese Koerner sind mit saueren und basischen Farbstoffen tingibel (amphophil); sie kommen im menschlichen Knochenmarke vor.

[1] Grundriss einer Klinischen Pathologie des Blutes, von Limbeck; Gustav Fischer, Jena, 1892. p. 132.

3. Die γ-Granulation oder die Mastzellenkoernung, Zellen mit feiner Granulation, welche basophil ist, das heisst aus einem Gemisch von Anilinfarben nur die basischen aufnimmt.

4. Die δ-Granulation, basophile Zellen, welche meist mononucleaer sind.

5. Die ϵ-Granulation oder die neutrophile Koernung, die haeufigste Form von allen, zeichnet sich gewoehnlich durch einen unregelmaessig eingebuchteten oder auch mehrere unregelmaessig contourirte Kerne aus, und nimmt aus einem Farbengemisch nur die neutralen Farbkoerper auf.

Size.—The average size of leucocytes in normal human blood may be taken as about 10μ (about $\frac{1}{2500}$ inch). They

vary in size exceedingly, some being smaller than the average coloured corpuscle, while others are more than twice as large.

Number.—The number of leucocytes in each cubic millimeter of normal blood varies widely in the same individual at different times of the day, and from day to day. From a number of observations made by myself with great care, I am led to take from 6,000 to 10,000 as the average in health,—rather a wide range. Limbeck, as cited, on page 134, gives the collated results of various estimates, ranging from 4,800 to 10,590. Osler, Principles and Practice of Medicine, 1892, page 699, takes 6,000 as the average in health. I think this estimate rather low.

Nuclei.—As mentioned before when describing the varieties of leucocytes, the number of nuclei varies, some leucocytes containing a single nucleus, others being multinuclear. Schäfer, in Quain's Anatomy,[1] speaking of the nuclei of leucocytes, says, "Thus a nucleus not unfrequently becomes elongated and either irregular in outline or folded on itself, so that when the ends are turned up, the appearance of two nuclei is produced, where in reality there may be but one. In fact the occurrence of several nuclei in the pale corpuscle is much more rare than is generally supposed, for it will be usually found that even when there appear to be several nuclei in a corpuscle they are united together by long strands of chromoplasm."

This is not in accordance with my observations; for, during an investigation of the nuclei of leucocytes of normal blood, undertaken in the fall of 1892, I found by staining that many leucocytes were multinuclear. This accords with what has been observed previously, as before quoted from Osler, who gives the polynuclear as 65 to 80 per cent. of all leucocytes. Probably in this estimate transitional forms were included.

[1] Quain's Elements of Anatomy. Longmans, Green & Co., London and New York. Tenth Edition. 1891. Vol. I., Part II., p. 214.

As to the classification of the nuclei of leucocytes, there are at least four varieties.

1. The ordinary single nucleus, with regular outline, circular or slightly elongated.

2. Single nucleus, with slight indentations.

3. Long moniliform nucleus, sometimes with as many as four constrictions. Some of these moniliform nuclei strongly recall the endoplast of certain Protozoa.

4. Several small nuclei in one cell. These leucocytes resemble ordinary pus cells, with three and sometimes four nuclei, much smaller than the nuclei of mononuclear leucocytes.

BLOOD PLAQUES.

These are usually called "third blood corpuscles." They are small colourless bodies, usually angular, varying in size from 2μ to 4μ. They are said to occur in proportion to the coloured corpuscles as 1 to 20.[1]

EXAMINATION OF LEUKÆMIC BLOOD.

In all the examinations of the blood of the patient referred to on page 311, great care was exercised in order that the facts here recorded may be exact and reliable, and of use in future investigations. More than the usual number of observations were made in each case.

COLOURED CORPUSCLES.

Size.— One hundred coloured corpuscles were measured, the average size being $\frac{1}{3088}$ of an inch, more than 8μ.

The largest were $\frac{1}{2222}$ of an inch, more than 11μ. Only three of these were found after an extended search.

The smallest was $\frac{1}{8000}$ of an inch, more than 3μ. It was regular in outline, appeared plainly bi-concave, and had the usual colour. I kept it under observation for some time, under the impression that it was the result of the disintegra-

[1] Gray's Anatomy, Lea Brother & Co. Philadelphia. 1887. p. 38.

tion of a coloured corpuscle, and it is quite probable that it was such a body. Eight were found whose size was $\frac{1}{5000}$ of an inch, or about 5μ.

Number and Hæmoglobin.—A careful enumeration of the coloured corpuscles was first made March 4th, counting the corpuscles in fifty squares. This resulted in 4,132,000 per cubic millimeter, or about 80 per cent. The estimation of hæmoglobin at the same time resulted in finding 40 per cent. Another enumeration made March 7th, counting one hundred squares, gave 4,188,000 per cubic millimeter, or about 80 per cent. The estimation of hæmoglobin at the same time gave 40 per cent. The number of coloured corpuscles then was about 80 per cent., and the hæmoglobin 40 per cent. of the normal number and quantity.

Shape.— In certain blood diseases many of the coloured corpuscles are very irregular in outline, assuming very peculiar shapes; not amœboid, but quite constant for any particular corpuscle. To these queer coloured corpuscles the term *poikilocytes* is applied. The writer looked long and carefully for poikilocytes, but not more than a dozen rewarded his search. The few irregular cells that were seen were shaped somewhat like Rupert's drops with short tails. One peculiar corpuscle was cigar-shaped, 5μ long and 1μ wide. A striking peculiarity was the absence of crenated forms. After making a number of examinations, none of the slides showed a single crenated corpuscle. One slide was kept one and one-half hours. At the expiration of that time the coloured corpuscles moved freely in the plasma when the slide was tipped, but none of the corpuscles were crenated.

Rouleaux.—In every examination of the blood by itself, without the addition of any reagent, rouleaux were formed as in normal blood. In one field two stationary leucocytes were so situated that when currents of plasma carrying coloured corpuscles flowed between them, the coloured cells were compelled not only to pass through in single file, but to squeeze

through, sometimes becoming stuck for some seconds. Rolls of coloured corpuscles would float up to this strait, detach themselves one by one, squeeze through the narrow way, and go floating away in the plasma stream. Soon some obstruction would check the journey of these coloured corpuscles, and as soon as they approached one another, rouleaux were formed, in many instances the corpuscles taking the same relative position that they occupied before entering the narnow strait.

LEUCOCYTES.

Size.—One hundred leucocytes were measured. The average size was $\frac{1}{2300}$ of an inch, or about 11μ.

The largest were $\frac{1}{1400}$ of an inch, or about 18μ. Three of these were found.

The smallest were $\frac{1}{5000}$ of an inch, or about 5μ. Two of these were found.

Number.—An enumeration of leucocytes was made March 4th, at the same time that the coloured corpuscles were enumerated. The leucocytes in fifty squares were counted, and the estimate of 294,800 leucocytes per cubic millimeter was made. Another enumeration was made March 7th, at the time of the enumeration of coloured corpuscles. At this time the leucocytes in one hundred squares were counted, and the result was 340,000 leucocytes per cubic millimeter. These estimates give the proportion of leucocytes to coloured corpuscles as 1 to 13. The writer's first glance through the microscope at this blood, led him to exclaim that the leucocytes were as numerous as the coloured corpuscles. Prof. Calvin's first observation led him to make the same exclamation, and Mr. Houser also entertained the same idea. As shown by the hæmacytometer, the proportion of leucocytes to coloured corpuscles was as 1 to 13. The illusion was due to two facts. First, we are accustomed to see but a few leucocytes in any one field; and second, the coloured corpuscles were in rouleaux, and only the edge of each was seen.

Nuclei.—Time would not permit a thorough examination by the use of stains, and in order to gain as much information as possible in the time which could be devoted to this part of the investigation, a weak solution of acetic acid was employed. This fact must be held in mind in making the application of my observations on these nuclei.

The three largest leucocytes seen, those mentioned before as being $\frac{1}{1450}$ of an inch, or about 18μ, in diameter, were mononuclear, the nuclei being of the first variety. The nuclei were $\frac{1}{2500}$ of an inch, or about 10μ, in diameter. Thus it will be seen that the nuclei of these three immense cells were as large as the average leucocyte.

The leucocytes containing nuclei of the second variety were of large size, all exceeding $\frac{1}{2000}$ of an inch, or about 13μ.

The leucocytes containing nuclei of the third and fourth varieties were of medium size, and ranged from $\frac{1}{2500}$ of an inch, about 10μ, to $\frac{1}{2000}$ of an inch, or about 13μ.

The lymphocytes were much smaller, the largest not exceeding $\frac{1}{2500}$ of an inch, about 10μ. Some were but $\frac{1}{3300}$ of an inch, about 8μ; in other words about the size of the nuclei of the mononuclear and transitional leucocytes.

As to the relative number of the various varieties, no attempt was made to estimate the percentages. Occasionally every cell in a field was examined, and almost every one would be of the large mononuclear type. Again, other fields contained almost an equal number of the larger mononuclear and the transitional leucocytes. The lymphocytes were by no means very numerous. It is to be regretted that opportunity was not afforded to make a thorough investigation of the nuclei of this blood, and estimate the per cent. of the various varieties of leucocytes, but the patient left the hospital March 8th, and the writer was not permitted to complete his studies by the use of stains and various reagents.

Amœboid Movement.—The blood was examined on the warm stage, March 6th. The temperature was maintained at about 35° C. The movement was quite sluggish as compared to that of leucocytes in normal blood.

Another more extended examination on the warm stage was made March 7th. At first very little amœboid movement of any kind was visible, probably because of the shock and the altered environment. After about ten minutes had elapsed, sluggish movements began to take place. All sizes of leucocytes showed amœboid movement. The larger cells moved much more rapidly than smaller, and all cells showing any considerable degree of locomotion were of large size, the small cells showing slight changes of outline.

BLOOD PLAQUES.

In every preparation examined without reagents, many leucocytes seemed to contain coarse granules in one hemisphere. Sometimes these aggregations of granules appeared to be crescentic, from the turning of the leucocyte. A number of these granule-like bodies were seen lying in masses in the plasma. At first I thought these independent masses of granules were the result of disintegration of leucocytes. A higher power revealed the fact that these granules were blood plaques. The coarsely granular appearance of one portion of certain leucocytes was due to the fact that blood plaques were adhering to the surface of the leucocytes. In no other specimen of blood examined by the writer have these blood plaques been so numerous or so conspicuous.

SUMMARY.

In the leukæmic blood the average diameter of one hundred corpuscles was $\frac{1}{3031}$ of an inch, which, although slightly larger than the average usually taken for coloured corpuscles, can not be considered to vary much from those in a state of health. The largest were $\frac{1}{2222}$ of an inch, the smallest, aside from the minute corpuscle described, were $\frac{1}{5000}$ of an inch.

The number of coloured corpuscles per cubic millimeter, estimated by counting those in one hundred squares of the hæmacytometer, was 4,188,000, about 80 per cent. of the number found in normal blood. The hæmoglobin was esti-

mated as 40 per cent. of the quantity found in normal blood; about one-half the quantity that should occur in the number of coloured corpuscles in this blood.

Very few poikilocytes were found. The lack of tendency of the coloured corpuscles to become crenated, even when such change was invited, was a peculiar phenomenon. Rouleaux were formed as in normal blood.

The average diameter of one hundred leucocytes was 1/[illegible] of an inch, which is somewhat larger than the average of those in normal blood. The largest were 1/[illegible] of an inch, the smallest 1/[illegible] of an inch.

An estimate of the number of leucocytes, made by counting one hundred squares of the hæmacytometer, resulted in finding 340,000 per cubic millimeter. The numer of leucocytes to the number of coloured corpuscles was about as 1 to 13.

The study of the nuclei of the leucocytes was not as thorough as could be desired. Nuclei of the four varieties were easily recognized.

The largest leucocytes predominated. Whether or not some of these were what are called *myelocytes* was not determined.

The amœboid movement on the warm stage was much more sluggish than that exhibited by the leucocytes of normal blood. The movements were usually a mere change of outline, and not that lively locomotion indulged in by certain leucocytes of normal blood.

Blood plaques were especially numerous, sometimes uniting to form masses of large size. Frequently leucocytes were seen with blood plaques adhering to one hemisphere, under medium powers giving the impression that the leucocytes contained coarse granules in one portion of their substance.

Histological Laboratory,
State University of Iowa.
March, 1893.

STUDIES ON THE MALE TARSUS IN SOME ADEPHAGOUS COLEOPTERA.

By H. F. WICKHAM.

Among many of the families of Coleoptera the tarsi of the males are modified in various ways, the better to secure their hold upon their mates during the act of copulation. In many genera of terrestrial Adephaga the joints of the middle or anterior tarsi, or both, are dilated and furnished beneath with pubescence, quite possibly glandular, which must aid them greatly in maintaining their place. When, however, we come to the Dytiscidæ, we find the most wonderful and beautiful transformations undergone by this sexual pubescence; it often takes the shape of expanded palettes, or "suckers" as they are sometimes called, which offer a large and mobile surface for the spread of a peculiar viscid fluid which secures immediate and firm attachment to any smooth surface to which they may be applied. The polished surface of the females of these insects, necessary for freedom of motion through the water in which they live, offers a perfect basis to which these disks may be made to adhere.

A very interesting article on the structure of the foot of Dytiscus has been given by Mr. B. T. Lowne in the Transactions of the Royal Microscopical Society for 1871. He has demonstrated the presence of a gland in the interior of the foot, which secretes a viscid fluid which is carried by ducts to the nipple-shaped attachment on which the base of the columella of the large palette rests. This columella is apparently hollow and open along one side; it is enclosed in the elastic

pedicel which supports the disk and is kept straight and the slit closed by the elasticity of this pedicel. When, however, pressure is applied against the surface of the disk, the pedicel is shortened and the columella bent, thus opening the slit and allowing the fluid to escape into the general cavity of the pedicel whence it is distributed over the surface of the disk. The small palettes, he says, have no columella, the pedicel is pointed, while the disk is cup-shaped and obliquely attached to the pedicel when at rest. When pressure is applied the disk is brought at right angles to the pedicel and opens communication with the secreting sac.

It is not my intention however to discuss the mechanism by which these sexual hairs are rendered serviceable, but rather to bring before the student some of the many patterns of arrangement of the disks and to figure as many as may be available for the purpose. It is quite possible that this structure might be used with profit in the identification of species in many cases, though in others, where the species are easily differentiated by other characters, the feet are almost indistinguishable.

Any classification founded on these hairs must necessarily be artificial, since it is a principle generally accepted among naturalists that those organs which are brought most into contact with the peculiarities of the life of an animal are those which are likely to undergo to the greatest extent the process of adaptation and change; and will consequently offer no reliable index of true fundamental or homological affinity though often valuable for defining groups among species closely allied.

The short note regarding generic peculiarities is taken from Dr. Sharp's great work on the Dytiscidæ.[1] The descriptions and drawings are original, the latter made after photo-micrographs, which, with the exception of two by Mr. L. B. Robinson, were all made by Mr. Edw. G. Decker, to whom I am greatly obliged for this kind aid. It is hoped to

[1] Scientific Transactions of the Royal Dublin Society. Vol. II, Series II.

continue the work until at least all of our most interesting American species have been figured, and any good material for the purpose will be very welcome.

CYBISTER.

Three basal joints of the male anterior tarsi dilated, forming a disk somewhat regularly transversely elliptical in shape, furnished with four rows of palettes, similar among themselves; the first joint bearing also a patch of pubescence of varying size.

CYBISTER EXPLANATUS Lec. Plate VI, Fig. 4.

Three dilated joints nearly equal in width, the basal one a little wider than both the others taken together. Palettes in four transverse series, the first situated just in front of the pubescent area, consisting of fourteen palettes and not extending quite across the joint; the second extends quite along the distal margin of the joint and consists of nineteen palettes; the third and fourth series occupy a corresponding position on the second and third joints respectively, and contain twenty-one and twenty palettes. The pubescent area occupies the base for a little more than one-half the length of the joint. Specimens studied from Yuma, Cal.

CYBISTER FIMBRIOLATUS Say. Plate V, Fig. 2.

A little larger than the preceding, but resembling it very closely in details. The first and second series have respectively fifteen and twenty palettes, while the third and fourth contain the same number as the corresponding rows in *C. explanatus*. Specimens studied from Iowa City, Iowa.

CYBISTER TRIPUNCTATUS Oliv. (*africanus* Lap.)

A prepared anterior tarsus of this species differs from either of the preceding as follows: The first series consists of nineteen palettes, the second of twenty-two, the third of twenty-two and the fourth of twenty-three. The pubescent area is

also considerably larger, extending much farther forward on the joint. Algeria.

It is perhaps worthy of note that there appears, with the scanty material at hand, to be a direct correlation between the size of the dilated tarsi and the number of palettes; thus in *C. explanatus* which has the smallest foot of the three species, I find only seventy-four palettes; in *C. fimbriolatus* with a somewhat larger foot there are seventy-six, while on the still larger one of *C. tripunctatus* there are eighty-six. The arrangement by series is given below.

	1	2	3	4	*Total*
C. explanatus,	14	19	21	20	74
C. fimbriolatus,	15	20	21	20	76
C. tripunctatus,	19	22	22	23	86

There may be a variation within specific limits as well as that which I have noted above, but material is not now at hand for the discussion of the question.

THERMONECTES.

Anterior tarsi of male dilated, the first three joints forming a nearly circular plate, furnished beneath with several palettes, the three basal often larger. Intermediate tarsi simple.

THERMONECTES ORNATICOLLIS *var.* NIGROFASCIATUS Aubé. Plate VIII, Fig. 7.

Patella equal in length and breadth, the basal joint longer than both the others. The palettes are arranged as follows: Three large ones forming a triangle, and six smaller, marginal on the basal joint; seven on the second and six on the third joint, arranged along the anterior and side margins and of about the same size as the smaller palettes on the basal joint. Fringing hairs, few in number, interrupted at the articulation of the tibia and of the fourth joint.

The palettes resemble those of *Dytiscus* much more closely than those of *Cybister*. It exhibits a high type of specialization in the reduction of the number of palettes, while on the

other hand there is little differentiation *inter se*. Studied from specimens taken at Albuquerque, New Mexico.

ACILIUS.

Anterior tarsi of male dilated, basal joint with three large palettes and patch of very small ones. Fringing hairs usually long. Intermediate tarsi little or not at all dilated.

A. FASCIATUS De G. Plate VIII, Fig. 8.

Basal joint of anterior tarsus much larger in proportion to the others than in any other species thus far studied. The sexual hairs are also very differently arranged, as follows: Basal joint with a very large palette near the proximal angle, two smaller palettes just beyond this, and a patch of very small long-stalked ones crowded together in the other angle. The second and third joints of the tarsus bear only the smallest size of palettes, a median space equal to somewhat less than one-third of the width of the joint being quite bare. The fringing hairs are very long and beautiful, reaching their greatest length in the vicinity of the large palette and becoming shorter and stouter as they approach the articulation of the fourth joint.

The differentiation of the palettes into three sets is very interesting and is the most characteristic feature of this foot. Prof. Nutting to whom I showed the drawings and notes has suggested that this indicates a high degree of specialization, the development of three sets differing widely among themselves, more than offsetting the great reduction in number of palettes with little difference *inter se* as shown in *Thermonectes ornaticollis*. One of the species of *Acilius* (*A. mediatus* Say) seems to show that quite possibly these two very differently appearing feet may be elaborations of a common type—that in the more typical species of *Thermonectes* the tendency has been along the line of reduction in number of the palettes with maintenance of comparative equality in size while in *Acilius* the three large palettes seem rather to have

been developed at the expense of complete suppression of all the glandular hairs in their neighborhood.

Studied from specimens sent from Switzerland, by Mr. Fritz Rühl.

DYTISCUS.

Anterior tarsi of male with three basal joints dilated and forming a large nearly circular patella, having two large palettes and numerous small ones on the first joint, and small palettes only on the second and third. Middle tarsi with the three basal joints dilated and clothed beneath with glandular or spongy pubescence. This is a large genus, and, with a pattern which is on the whole very constant, shows many minor variations. Of the five species I have been able to study, four are figured.

D. MARGINALIS Linn. Plate VII, Fig. 6.

Two large palettes on basal joint and about forty-three small ones, the latter arranged in five tolerably regular transverse rows of which the marginal one contains eighteen palettes. Second joint with two complete transverse rows of small palettes and a few intercalated—one at one end, five at the other—forty-three in all. Third joint with confused rows of small palettes, about sixty-eight in number.

Studied from European specimens. Resembles very closely the foot of *D. fasciventris* Say. A large palette of this species is shown on Plate VIII., Fig. 11.

D. FASCIVENTRIS Say. Plate V, Fig. 1.

Very closely resembling the preceding species, the patella however being a little more elongate, the basal joint comparatively narrower and longer. The marginal row on the basal joint consists of only fourteen palettes and there are but eleven others on the joint besides the two large ones. The second joint bears an anterior and posterior marginal row of respectively twelve and fifteen palettes with a single marginal one intercalated. Third joint with forty-two small disks arranged in somewhat regular transverse rows.

The foot is of smaller size than that of *D. marginalis* and offers another example of the correlation between size of patellæ and number of palettes spoken of in the remarks under *Cybister tripunctatus*. This parallel does not however, hold good in such forms as *D. harrisii* and others where the small palettes are comparatively much less developed, and will probably apply only between closely allied species.

DYTISCUS CIRCUMCINCTUS Ahr. Plate VII, Fig. 5.

Patella nearly circular in outline, not elongate. The palettes are smaller and more numerous than in either of the preceding species, the marginal row of the first joint containing twenty-one, while the angle bears thirty-five others. The second joint bears five illy defined series of them instead of the two seen in *D. fasciventris* and *D. marginalis*, while the third joint has a great number placed confusedly with scarcely a tendency to arrangement in lines.

DYTISCUS PUNCTULATUS Fabr.

Resembles *D. circumcinctus*, but the small palettes are still more numerous, especially on the second joint where about eight much confused rows can be made out. It approaches the next species in structure.

Studied from European specimens.

DYTISCUS HARRISII Kirby. Plate VI, Fig. 3. Plate VIII., Fig. 9.

Patella slightly elongate, third joint more deeply notched at apex than in the other species. The small palettes are minute, very closely placed and extremely numerous. There are two nearly complete rows on the basal joint, the second has about ten, very much confused, for the greater part of the width.

This species shows a slight indication of a bare median space on the third joint, reminding us of the structure shown in the foot of Acilius. The middle tarsus as figured shows very

well the structure of these parts in all the species of *Dytiscus* which I have studied, the chief difference lying in the density of the vestiture. There seems to be no direct correlation between the number of palettes on the anterior feet as compared with the intermediate.

COLYMBETES.

Composed of species with very heterogeneous male characters — anterior tarsi either dilated or compressed, with or without palettes and glandular pubescence.

COLYMBETES SCULPTILIS Harris. Plate VIII, Fig. 10.

Anterior tarsus dilated, not compressed, basal joint with twelve palettes in two rows of six each, those in the marginal one with longer stalk than the others; a median irregularly Y-shaped patch of pubescence. Second joint with a single submarginal row of six; third joint with one of four palettes all alike.

No true palettes are visible on the tips of the sexual hairs in my specimens, but I suspect they may have been accidentally removed, either in preparation of the slide or before the insect came into my hands.

Studied from specimens from Michigan. This foot recalls that of *Cybister* in the arrangement of the rows of palettes as well as in the possession of the patch of pubescence on the heel.

DESCRIPTION OF THE EARLY STAGES OF SEVERAL NORTH AMERICAN COLEOPTERA.

By H. F. WICKHAM.

The following notes refer to the transformations of several Coleoptera which have not heretofore been described in the literature of the subject, and are offered as a continuation of the series begun in the preceding number of the Bulletin. While it is to be regretted that the works of Schiödte and Perris are not accessible in order that these insects might be compared with their near European relatives, I have tried to make the descriptions and figures clear enough to serve, if necessary, as a basis of comparison in treating of others in the future. The preparatory stages of American beetles have been sadly neglected, in consequence probably of the difficulty of successfully carrying larvæ to their full growth and through their final transformations.

PTEROSTICHUS LUCUBLANDUS SAY. Plate IX, Fig. 5.

The larva of this species has been carefully described by Schaupp in the Bulletin of the Brooklyn Entomological Society, III, p. 88. A figure of the pupa drawn only an hour before the emergence of the beetle is given herewith to complete the history. The length is 10 mm.

A larva found at Independence, Ia., on the first of September, pupated on the sixth and the perfect insect appeared on the sixteenth.

BRACHINUS JANTHINIPENNIS Dej. Plate IX, Figs. 1 and 2.

Color of living larva clear white with a dark dorsal line

caused by the internal organs showing through. Mouth-parts castaneous.

Form short and thick, cylindrical, tapering at the ends. Length, 9 mm.

Head small, sides rounded.

Prothorax broader than the head, margins crenated, separated from the disk by an impressed line. Surface very convex.

Meso- and metathorax shorter and narrower than prothorax. Abdomen broader than prothorax, the segments bulging considerably, bristled at the sides beneath. The general shape of the larva is shown by the figure in which however the head and thoracic rings are drawn a trifle too broad in proportion to the abdomen—the result of attempting to correctly represent a living and moving specimen.

Legs in the form of an elongate cone, the joints regularly decreasing in diameter from base to tip. There are no true claws, but on three of the legs I can make out, with a three-fourths objective, two diverging bristles near the tip of the tarsal joint which may be the homologue of the claws. As the possession of two claws has been looked upon as characterizing the larvæ of Adephaga, this is an important point.

The larva shows to a remarkable degree, the profound modifications which a change of habit may bring about. Belonging to a family the larvæ of which are mostly active and strong, living by rapine and murder, the larva of *Brachinus* is a parasite on insects of its own order and is subject to the many degradations of structure brought about by this habit. Living in the cells or "cocoons" of *Dineutes assimilis*, where it is perhaps brought as a very young larva clinging to its host, it is without need of hard chitinous covering to protect it from enemies or strong limbs to bear it in search of prey. Its covering is consequently soft and yielding, resembling rather that of a Hymenopterous larva than a Carabid, the legs become mere props and seem not to be used in drawing the body along when the insect makes the little progress of

which it is capable. The abdomen is unwieldly in size and the long caudal processes so often seen in this family are reduced to mere tubercles. The ambulatory bristles are weak. The mouth parts are minute and it is to be regretted that the scanty material does not permit of dissections which ought to be made. Transformation to the pupal state takes place in the cell of its host. The pupa is white in color, 7 mm. in length, the posterior tarsi exceeding the tip of the abdomen. The antennæ are passed under the anterior and middle legs, the tips meeting at the point of origin of the posterior tarsi. The posterior legs are covered as far as this point by the wing-pad.

Two of these larvæ were found in the cells of *Dineutes assimilis* feeding on the pupæ and sucking the juices. One of these, perhaps an account of the partial decomposition of the *Dineutes* pupa on which it it was originally feeding, consented to complete its growth on a pupa of *Tropisternus glaber* which I killed and opened for it. Taken on the first of September, the change to pupa was made on the seventh, the perfect insect appearing on the sixteenth. The larva had a curious habit when disturbed of lifting the fore part of the body so that all the feet were in the air—much after the attitude taken by *Sphinx* larvæ—and maintaining this position for some minutes.

SCARITES SUBTERRANEUS Fab. Plate IX, Figs. 3 and 4.

Color of larva, black above, excepting the side margins of the metathorax and of the abdominal segments which are of a dirty white. Sides of abdomen white with a longitudinal series of small brown spots. Legs brown.

Form elongate, subcylindrical; length about 33 mm.

Head about as wide as the prothorax, bristly, frontal margin tridentate.

Eyes situated behind the antennæ, composed of six ocelli, in two transverse rows of three each. If there are other ocelli I am unable to demonstrate them, as the details have to be made out from the cast skin of the larva after pupation.

Antennæ four-jointed, inserted on a tubercle, first joint short, the second a little over twice as long, the third a trifle longer than the first, the fourth only about one-third as long and tipped with three long bristles.

Mandibles stout, curved, with a double median tooth, blunt in the full-grown larva.

Maxillæ with a long basal joint equal to the first two joints of the antennæ. This joint is slightly curved, does not taper, and is very densely spinose on the inner surface but with long bristles on the other. The outer appendix is four-jointed, the first joint stout, about half the length of the second and somewhat exceeded by the third, the fourth joint being very small and pointed at tip. The inner appendix is two-jointed, the first joint stouter and a little longer than the second.

The mentum is small, broader at apex, extremely bristly. The palpi are two-jointed, the first joint stouter and about one-half longer than the second.

The separate description of the segments cannot be taken up as all form was of course destroyed by the process of casting the skin in transformation.

Legs stout, the coxæ conical and prominent, the femora a trifle shorter, the suture of the trochanter distinctly marked. The tibia is much shorter, not being equal to the tarsal joint with claws.

Pupa dirty white, 15 mm. in length, the head and jaws very large. It is remarkable chiefly for the large bunches of bristles which adorn the first five segments of the abdomen.

GYRINUS PICIPES Aubé. Plate IX, Fig. 6.

Color of larva dirty white, with a shade of yellow and an indistinct dorsal brown line. Eye-spots black, filaments clear white.

Form elongate, tapering to both ends, in section elliptical. Length 10 mm.

Head elongate, sides nearly straight.

Prothorax wider than the head, narrowed and rounded in front, with a distinct longitudinal slightly oblique impression.

Mesothorax broader than the prothorax, with an entire transverse impressed line anteriorly and two lateral ones, the inner plainer.

Metathorax resembles the mesothorax.

Abdominal segments 1 to 8 with a transverse impressed line at the base, sides margined.

Antennæ situated behind the mandibles, four-jointed the first joint short and stout, the second long and slender, the last two decreasing in length. Bristles wanting.

Mandibles as in *Dineutes*.

Maxillæ as in *Dineutes*, the palpi proportionately a little shorter.

Labial palpi also as in *Dineutes*.

Abdominal hooks as in *Dineutes*.

The pupa somewhat resembles that of *Dineutes* and is 4 mm. in length, white, the antennæ projecting at right angles from the sides of the head. The labrum is very distinct and the head has a large prominence on each side just above the antennæ.

As to the method of pupation I find there is a great deal of contradiction among different writers. Letzner[1] states that pupation takes place in the leaves of water-plants, reeds, etc., in a cocoon. Schaupp[2] says that they "make a gray paper-like cocoon under the bark of old willow-trees, etc.," while Packard[3] remarks that they "spin an oval cocoon." The discrepancy between these last statements is very marked, my observations going to uphold rather that of Schaupp since the cells I found were of mud without any intermixture of silk and so can hardly be said to have been "spun." Probably the larva uses any readily accessible matter in the formation of its cell and when under stones would use mud, while if under bark might there utilize wood or bark fibre thus giving the "cocoon" a papery consistence. A cell in my possession is

[1] Zeitschrift fuer Entomologie. Breslau, 1855. p. 4.

[2] Bulletin of the Brooklyn Ento. Soc., II, p. 22.

[3] Guide to the Study of Insects. 8th edition, p. 437.

elliptical in longitudinal section and measures 5 mm. in length by 2.5 mm. in breadth.

The figures of the larvæ are also apparently defective, the head, in the figures given by Packard and Letzner being out of all proportion to the body. Schaupp has correctly described the head as small.

Some doubt attaches to the specific determination of this larva as two or three species of *Gyrinus* may often be found in the same school. The specimens of beetles which I took from the cells, though immature, seem to be *G. picipes* and I have accordingly described the larva under that name. I consider it very doubtful if the larvæ of *Gyrinus* can ever be specifically distinguished.

I have given on Plate IX, Fig. 7, a representation of an unknown larva of this family, 16 mm. in length. I am unable to make a probable conjecture as to its identity unless it is possible that the larvæ of this family pass through a semi-pupal metamorphosis, and in that case it may be a feeding larva of *Dineutes assimilis* or possibly one of the other species of the same genus. It was captured close to the river bank at Independence, Iowa, on the first of September, and has lived five weeks in a tin box without food—refusing everything offered.

DINEUTES ASSIMILIS Aubé. Plate IX, Figs. 8 to 12.

Color of larva dirty yellowish white, the meso- and metathorax and dorsal portion of abdomen light slaty blue. The head, especially the mouth parts, and the prothorax are tinged with reddish yellow. Eyes black. The only distinct markings of any kind consist of two dark brown lines on the prothorax, one curved, sub-basal, the other shorter, basal.

Form, fusiform, not, or only very slightly flattened dorsoventrally. Entire length 25 mm. of which 3 mm. belong to the abdominal appendages.

Head subquadrate, somewhat narrowed anteriorly and posteriorly, a V-shaped mark between the eyes. Frontal margin (corresponding to labrum, but not separated by a distinct

suture) with three teeth, the middle one large and rounded, the lateral ones smaller and pointed.

Eyes on a raised black spot, posterior to the antennæ. The appearance is of six ocelli, of which four are situated on the upper surface of the head as shown in the figure, while the two larger ones are rather anterior and inferior to them in position.

Antennæ inserted immediately behind the base of the mandibles, on a tubercle, four-jointed, the first joint short and stout, the second long, third and fourth shorter, the fourth being shorter than the third. There are no bristles.

Mandibles curved, acute, moderately stout and without teeth, the inner margin showing only a slight roughening even under a one-fifth objective.

Maxillæ very stout and heavy. The first joint is long and heavy, the second joint heavy but much shorter, having three appendages; internally a long slender tooth, notched at tip, externally a long four-jointed palpus of which the first joint is short and the remaining three longer but nearly equal among themselves, though the second is the longest, and between these two appendages is situated a third, two-jointed one. The only bristles visible are two in number and situated at the base of this last-mentioned appendage.

Mentum. I think I am correct in describing this as small and covered at base by a lobe of the under surface of the head. The palpi are very long, three-jointed, the basal joint stout, the remaining ones more slender. It is possible that what I have described as the basal joint may be a supporting piece, like that found in the larva of *Omus*.[1]

Prothorax narrowed in front and having on the dorsal surface a corneous scute, the posterior margin of which is bounded by a dark brown line. Disk convex, sides nearly straight, base and apex slightly sinuate.

Mesothorax somewhat broader than prothorax, narrowing anteriorly from a point quite near the base.

[1] Horn, Trans. Am. Ent. Soc., VII, p. 33.

Metathorax similar to mesothorax. There are no bristles of any size on any of the thoracic rings so far as I can discover.

Abdomen very long, the segments 1 to 8 approximately equal in length. Each of these bears, near the posterior angle, a long white filament or process, which, when the larva is curled in its cell is applied close to the body. In the water they presumably move about quite freely. The ninth segment is smaller and bears a pair of these appendages on each side; between and inferior to these appendages is borne a small additional segment which in turn is surmounted by a smaller one, armed at tip with four long curved hooks.

Spiracles cannot be found. It is quite possible that true stigmata do not exist and that the filaments form the only external respiratory organs. This is rendered more likely from the fact that each filament is again covered by much smaller ones visible only under high powers of the microscope.

Legs with prominent conical coxæ, femora a trifle shorter, tibiæ about half the length of the femora, tarsal pieces a little longer and bearing two nearly straight equal claws. The coxæ are slightly bristled, the other joints have all strong spines on the outer edge.

The pupa is 8 mm. in length, yellowish in color and the eyes are nearly black. The abdomen and nearly the entire dorsal surface are brown. It is much more quiescent than usual with the coleopterous larvæ, and I have never seen more than the faintest perceptible movement of the abdomen. It is preyed upon in its cell by two different parasites—one the larva of the *Brachinus* before described and the other a minute Hymenopterous insect of the family Chalcididæ. A specimen which was about to disclose the perfect insect increased in length and the limbs became more free.

Several specimens of larvæ and pupæ were found in their cells or "cocoons" along the bank of the Wapsipinicon River near Independence, Iowa, during the last of August and beginning of September. The larvæ, on coming out of the water, repair to the under surface of a stone or a board, close

enough to the water's edge to insure continued dampness, and there construct an oval cell of earth, without any admixture of silk so far as I can find. These cells are not simple excavations of earth beneath the stone, but are built upon it like the cells of some of our mud-wasps and are not very unlike them in shape. A cell in my possession measures 12 mm. in long diameter and 8 mm. across, outside. In it the larva lies curled somewhat in the form of a letter C until changing into a pupa which rests upon its back—a position also assumed by the perfect insect when it is at last disclosed. Escape seems to be made by forcing out one end of the cell as nearly all the empty ones I saw were broken in that fashion.

The drawings and descriptions are made from full grown larvæ taken from their cells but not from those so far advanced as to be unable to run. All students of Coleoptera know that in the active species the larvæ undergo considerable change of form just previous to transformation.

TROPISTERNUS GLABER Herbst. Plate IX, Figs. 13 to 15.

Color brown above, tubercles and a stripe down the back lighter. Beneath yellowish, the tips of the femora and tibiæ brown. Head, above brownish with a yellow stripe each side, beneath brownish, with a median and two pairs of lateral stripes yellow, the outer one broader. Prothorax with a crescentic yellow mark on the under surface.

Form depressed, tapering to both ends. Length 14 mm.

Head subquadrate, a little narrowed posteriorly, not continuing the axis of the body but directed somewhat upward. The upper surface is convex between the eyes but with a flat space near the base; below convex but with a well-marked flattened semicircular area immediately posterior to the mentum. Frontal margin entire.

. Eyes situated behind the antennæ, consisting of six ocelli on each side, arranged in two transverse rows of three each. The outer ocellus of the posterior row is undeveloped in some specimens.

Antennæ inserted just behind the mandibles, three-jointed, the first joint very long and heavy and bearing numerous bristles internally. Second joint short, more slender, third still shorter and slenderer, tipped by a long bristle. I have a carefully prepared dissection of the top of the head of this species and am positive that there is no basal joint "gros et court" such as M. Eug. Duges[1] has credited to the larva of *T. lateralis*. The antennal tubercle has the appearance of a joint in the natural specimen but when cleared and examined under the microscope it is seen not to be a true joint since there is apparently no suture.

Mandibles strong, curved, with a large and strong tooth about the middle, below which is a much smaller blunt one.

Maxillæ longer than the antennæ, five-jointed,[2] first joint long and heavy, only slightly bristly. Second joint shorter, bearing internally at the tip a small bristle-tipped tubercle. Third joint about one-third the length of the second, fourth about the length of the second, fifth again shorter and pointed at tip.

Mentum transverse, the anterior angles prominent and produced, bearing four spines on the under surface near the base of the ligula, which is sub-oval narrowed to the base, apex bearing the two-jointed palpi of which the second joint is about three times the length of the first and tipped with one long and two short bristles. Between the palpi is an appendix or process, probably the latter, as I can find only a mere indication of suture—which is about twice the length of the first joint of the palpi.

Prothorax narrowed in front, apex arcuate and sinuate, partly covering the base of the head. The anterior margin is depressed and longitudinally striate, the posterior margin smooth, while the disk is covered with granules.

Mesothorax shorter and broader than the prothorax and

[1] Ann. Soc. Ent. Belg., XXVIII, p. 8.

[2] Duges (*loc. cit.*) calls them six-jointed in *T. lateralis*. I cannot find a basal joint in my species.

covered with granules, except on two spots, one on each side of the middle posteriorly. Just external to this spot is an oblique elevation extending downwards and forwards, while exterior to this is another larger lateral one, bearing on its summit three tubercles.

Metathorax similar but lacking the two smooth spots.

Abdomen composed of rings which in dorsal aspect much resemble the metathorax but which are so plicate transversely as to be with difficulty separated from each other. The segments continue of about the same width until the third or fourth is reached, when they decrease to the tip. A prepared skin shows each segment except the last to bear two scutes, a smaller anterior and a larger posterior one.[1] All the scutes are covered with tubercles, conspicuous among which are a series of larger ones down the middle of the back, consisting for the greater part of the distance of two tubercles placed one behind the other on each side of each large scute. Laterally the segments are longitudinally plicate, and bear each a bristle-tipped tubercle. The under surface of the segments, except the last two, are marked by four transverse ridges, limited on each side by a longitudinal depression outside of a high ridge.

Legs moderate, coxæ large, conical and prominent, femoral piece with a distinct trochanter and longer by a trifle than the coxæ. The tibia is shorter than the femur, and the tarsal piece still shorter, being in fact merely a long claw.

The pupa is white, eyes a light chestnut and a spot on the abdominal dorsum, black. The pronotum is armed at the anterior margin with a number of long curved bristles—three near each angle and two on each side of the middle; there are also two near each of the posterior angles and several on the disk. The abdomen is armed with stiff bristles placed in rows as follows: two dorsal, one on each side dorso-lateral in immediate proximity to the spiracles, and one lateral just below the spiracles. The tip bears two fleshy curved pro-

[1] Duges considers the larger one anterior. (*l. c.*, p. 9.)

cesses without evidence of segmentation. The wings are overlaid by the anterior and middle legs, and partially overlap the posterior ones. The palpi are directed away from the head, pointing towards the tip of the abdomen, but the antennæ are directed from the neighborhood of the eyes to the posterior angles of the prothorax under which the club is received. Length 10 mm.

Larvæ and pupæ were found under stones along the banks of the Wapsipinicon River, at Independence, late in August. The larvæ repair to the under side of a stone and excavate a gallery at the end of which a smooth cell is formed by the squirmings of the insect. In this cell the transformations take place. Larvæ which I brought home with me pupated on the 6th or 7th of September and the perfect insects appeared on the 11th.

CRYPTOBIUM BICOLOR Grav. Plate IX, Fig. 16.

Length of pupa, as it rests slightly curved 4.5 mm. Color white, eyes very light brown. The head is flexed upon the thorax, the antennæ being tucked in between the knees of the anterior feet and the thorax, curving around again so as to be visible just posterior to the knees of the middle legs when the pupa is viewed ventrally. The most striking character however is found in the extremely long and slender bristles of which the majority project nearly on a plane passing from side to side of the body and keep the pupa always on its back. Three pairs of the abdominal bristles project nearly at right angles to this plane and these seem to be the main factors in producing the rapid motions of which the pupa is capable, the others serving chiefly to hold the body steady.

One specimen was found under a stone on the banks of the Wapsipinicon River, near Independence, Iowa, Sept. 2nd. It was exceedingly sensitive to the touch, and by means of the wonderful bristles with which it is armed was able to move about in a very lively way.

The perfect insect was disclosed Sept. 8th.

APHORISTA MOROSA Lec. Plate IX, Fig. 18.

The figure of the pupa of this species is introduced for comparison with that of others of the family already figured. These are (in American literature) only two in number, viz: *Aphorista vittata* Fabr., described and figured by Prof. John B. Smith in Entomologica Americana, II, p. 85, and *Epipocus cinctus* Lec., of which I have given figures and descriptions in the current volume of this Bulletin. A marked similarity will be seen to exist between all three.

In one of my specimens the anterior pair of lateral appendages are black. The material was sent me from California by Dr. Blaisdell.

CHAULIOGNATHUS PROFUNDUS(?) Lec. Plate IX, Figs. 17, 17*a*, and 17*b*.

Color of larva dark velvety brown above, almost black, a rosy line running from apex of prothorax to the tip of the seventh abdominal segment. The prothorax is margined with creamy white, narrowly at apex, more broadly at base, very broadly at the four angles. The mesothorax and metathorax are broadly bordered at base with delicate rose pink, while the segments 1 to 5 of the abdomen are tipped with the same color. The remaining segments have the tips and prominent posterior angles of a cream color, which in the last two extends up the sides as well. Viewed from below the prothorax is cream colored with two longitudinal brown stripes on each side of the middle and a round spot between the coxæ which are brown at base. The meso- and metathorax are rose pink beneath, with brown markings of which the most prominent are as follows: one rounded, almost divided by a longitudinal white line, slightly anterior to the inter-coxal space and a large curved one on each side just anterior to the coxæ, which are brown at base. In addition to these, the metathorax has a pair of large brown spots on each side near the anterior margin which are not found on the mesothorax, and between these pairs a rather indistinct geminate spot.

The abdominal segments 1 to 5 are rosy beneath, with a large quadrate median basal brown spot and on each side of this a large sub-orbicular or oval one. The remaining segments have as ground color a creamy white, the markings on the sixth and seventh segments being the same as the preceding ones. The last two are plain. The legs are creamy white except the bases of the coxæ and some longitudinal stripes on the other joints, which are brown.

Form elongate, somewhat depressed, tapering behind. Length 36 mm.

Head very small, covered in great part by the prothorax. Most of the mouth parts and a quadrate mark reaching from near the base to the frontal margin are castaneous. The form of the head is peculiar, the appearance being as if a tube were extended from the prothorax, the mouth parts and antennæ protruding from the end of this. I presume that the head is strongly retractile.

Antennæ with the basal joint immensely thick, the second shorter and much more slender, the third approximately equal in length to the second but of less diameter, the fourth very minute. All bear bristles. In color the first joint is white, the second is of the same color but with a brown band at about the middle of its length, the remaining two being castaneous.

The mandibles are strong at the base, curved, extremely slender and acute towards the tip. There is a strong sub-basal tooth, directed slightly upwards.

Maxillæ very thick, short, bristly, the joints decreasing rapidly in diameter. Without dissection I do not feel able to pronounce upon details.

Mentum apparently quadrate with the anterior angles produced. The palpi are short, bristly, and very thick.

Prothorax longer than wide narrowed and rounded in front, with a slight apical emargination, hind angles rounded. Surface minutely rugose, a patch of large deep punctures being arranged in irregular lines on each side of the middle. Near the base is a vague transverse impression, more evident at

the angles. Behind this is a fine transverse impressed line, not attaining the angles.

Mesothorax subquadrate, angles obliquely subtruncate, disk with a longitudinal elevated line on each side of the middle, not attaining the base. On each side of this line are large punctures, arranged in lines near the margin which has a coarse bead. Base with fine, distinctly impressed transverse line.

Mesothorax almost exactly the same but shorter.

Abdomen with the first and second segments nearly equal, though the second is a trifle longer, the third and fourth still longer. The posterior angles of all the segments are prominent, the prominence becoming more pronounced as we approach the terminal pieces. The ninth segment bears a fan-shaped pro-leg, with scalloped edges, on its under surface, while the eighth carries four bristle-tipped locomotive tubercles beneath.

Spiracles situated in the lateral brown spots previously mentioned. The mesothoracic pair are anterior to the coxæ, the abdominal pairs being situated a little nearer the base than the apex on segments 1 to 7.

Legs moderate, femora long, suture of trochanter tolerably well marked, coxæ and tibiæ about equal in length, shorter than the femora. Tarsal piece, a mere claw.

One specimen was collected by me in the Santa Rita Mts., Arizona, during August. The mouth parts are difficult to examine without dissection which does not seem warranted by such scanty material. The specific assigment is somewhat doubtful and is based on the fact that *C. profundus* is the only species of sufficient size in the imago state to warrant the supposition that it is produced from such a large larva, and occurs not uncommonly in the same region. The colors are all present and bright in an alcoholic specimen. Some structural divergencies may be noticed between my specimen and the figures given by Dr. Riley[1] of *C. pennsylvanicus*, a much smaller species.

[1] American Entomologist, III, 249. Fourth Rept. U. S. Ent. Com., 96.

A BOTANICAL EXPEDITION TO NICARAGUA.

By B. SHIMEK.

This expedition was sent out by the State University of Iowa under the auspices of the Nicaragua Canal Construction Company. That it was possible to send out such an expedition, and that it was successful, is due in a large measure to Hon. Warner Miller, of New York, President of the Nicaragua Canal Construction Company, who extended every aid possible by placing the resources of the Company in Nicaragua at the disposal of the expedition. Letters from President Miller secured transportation from place to place in Nicaragua, and quarters and other valuable aid in Greytown and Castillo.

The officers of the Company in Greytown, Castillo and elsewhere treated the members of the party with uniform kindness and courtesy, and furthered the objects of the expedition in every possible manner.

Thanks are also due to Hon John F. Duncombe, of Ft. Dodge, Iowa, and Assistant President John Dunn, of the Illinois Central Railroad, who kindly assisted the party in the matter of transportation.

The writer, accompanied by Mr. C. L. Smith, left Iowa City for New Orleans, December 16th, 1892, going thence by steamer to Greytown, Nicaragua, by way of Bluefields.

After a most delightful journey which brought about a gradual change from the snows of Iowa to the summer sun of the tropics, the party landed at Greytown on the 29th day of December. Inasmuch as the dry season begins earlier in the

interior than it does on the eastern coast, it was decided to push on to the island of Ometépe in Lake Nicaragua, the most distant point of the proposed route.

This journey was accomplished by steamer on the San Juan River from Greytown to Ft. San Carlos, and by the lake steamer "Victoria" to Ometépe.

As the "Victoria" was being repaired, a delay was occasioned at Ft. San Carlos from the 31st of December to the 5th of January. The time so spent was utilized in making observations on the topography of the vicinity, and on the customs of the people, and in collecting Phanerogams and Fungi, the latter being found principally on the wood which was stored for fuel on board the steamer.

OMETÉPE.

The village of Moyogalpa, on the northwestern shore of Ometépe, was reached in the evening of January 5th, 1893, and active preparations for work were at once made.

Ometépe is a volcanic island about twenty miles long, lying near the west coast of Lake Nicaragua. Its general form is that of a figure 8, each loop consisting of a volcano surrounded by a plain of varying width. The explorations were all made on the northern portion of the island which is occupied by the volcano Ometépe, and were limited to its western half.

Surface Features.

On the north the volcano slopes abruptly to the lake, but on the west and north-west are broader areas of comparatively low lands which are covered with dense forests interspersed with numerous plantations. To the north of Moyogalpa the coast is swampy.

The broad lower lands rise gradually to the foot of the volcano and are cut by occasional deep gullies in which are found numerous ferns, *Gymnogramme calomelanos*, Kaulf. being the most common, in some places also covering the otherwise almost bare surface of the volcanic ridges.

Neither streams nor springs are now found on the Ometépe portion of the island; the rock and soil are everywhere volcanic.

The volcano itself is an almost perfect cone rising 5,240 feet above the surface of the lake which is about 110 feet above sea-level. Evidences in the form of tree trunks and stumps indicate that it was formerly covered with dense forests to the very summit, but the eruption of 1883, (the first in historic times) destroyed the vegetation on the volcano, and even to-day the surface of the south-west quarter of the volcano is covered with loose volcanic sand and boulders, with no other trace of recent vegetation, than a few stunted, struggling mosses. The remainder of the volcano is again covered with low masses of tangled vines and shrubs, larger trees occurring only near the base, and on the eastern and south-eastern slopes.

As a clearer idea of the exact character of the surface of the western half of the volcano can perhaps be obtained from a detailed description of an ascent of the volcano made on the 24th of January, 1893, a portion of the notes which were taken by the writer at the time is here inserted:

"We started on horse-back with our guide at about seven o'clock, A.M. After passing a number of plantain plantations we entered a dense tropical forest by a narrow path overhung with branches and vines, a constant menace to our safety. We tried to reach San Marco on the north-western slope, the point from which the volcano is usually approached, but a fallen tree prevented this. After collecting for a short time in a deep gully which was washed out in the volcanic sand, at the foot of the volcano, and which was lined whith numerous species of *Pteris*, *Polypodium*, *Asplenium*, *Blechnum*, *Gymnogramme*, etc., we passed to one of the long, comparatively barren tongues of volcanic matter which extend out into the more fertile portions of the island, and gradually ascended to a point at an elvation of about 1,000 feet, beyond which horses could not be used. Leaving our horses at this point we commenced the ascent on foot about 10:30 A.M., and reached the summit in four and a-quarter hours. The line which we fol-

lowed is almost exactly due east from Moyogalpa, and is the dividing line which separates the bare sandy part of the volcano on the south-western slope from that on which vegetation has again obtained a foot-hold.

"Above the point at which we left our horses, for about 2,000 feet, the slope is about 30°; the surface is grassy with some shrubbery in the upper half of this portion, and with an abundance of boulders everywhere.

"Beyond this, in the last 2,000 feet, the slope becomes more abrupt, being about 45°.

"The lower part of this portion contains an abundance of small shrubs and a few young trees, and everywhere dead trunks of trees are standing erect, or lying where they were overwhelmed by the mass of volcanic sand which was hurled from the mouth of the crater. The upper part is almost bare, and as the soil is made up of fine, loose sand and small boulders, climbing is exceedingly difficult, the great exertion causing my (the writer's) pulse to reach 160.

"In the last 1,000 feet the sides of the gullies which have been produced by erosion since the eruption, show that this fine volcanic sand is regularly stratified, the lines of stratification being parallel to the slope,—evidence that the sand was deposited by the hot water which was ejected from the crater.

"The few herbs and shrubs which are found on this portion of the volcano are clustered together in patches in true alpine fashion, but the clouds which usually hang over it keep it constantly moist, and it is evident that a luxuriant vegetation will soon again creep out over the now barren surface.

"The summit of the volcano is somewhat obliquely truncate, the northern portion being the highest, and the eastern the lowest, while the crater is rather regularly obconical, and probably 1,000 feet in diameter, and about 500 feet deep. Its inner slope is about 45°, the surface being made up of the same kind of sand and boulders as occur on the outer part of the volcano, so that, were it not for the sulphur-fumes, a descent into it would not be more difficult than the ascent of the vol-

cano. A rift on the north-eastern side toward the Indian village Alta Gracias, mars its symmetry; the space at the top between its inner slope and the outer slope of the volcano is very narrow, being not more than one to three yards in width. On the eastern side there is considerable burning sulphur, the fumes of which greeted our nostrils 500 feet below the summit. Ordinarily the summit is capped with clouds, but to-day it is clear, and a magnificent view of the island, the lake, the mountains of Nicaragua and Costa Rica, and the Pacific Ocean is presented. . . . .

"A few *Coleoptera* and *Orthoptera* were collected quite near the summit of the volcano. The *Coleoptera* were easily picked from the white blouse of our guide to which they were attracted by its color, while the *Orthoptera* were found principally on the bare volcanic sand.

"The descent to the camp was made in a little more than one hour, the loose sand enabling us to slide down rapidly."

Here, then, in a few hours travel we may pass from the swamps of the coast to an elevation of over 5,000 feet. This variation in the surface features,—the swamp, the forest, the mountain,—all within easy reach from Moyogalpa, affords a variety of habitats for plants, a fact which makes Moyogalpa an excellent base of operations for the collector. Madera, the volcano on the southern portion of the island, 4,190 feet above sea-level, would no doubt offer many superior advantages in higher altitudes as its surface has not been disturbed by eruptions within the memory of man and is consequently covered with dense primeval forests.

The forests however which cover the greater portion of the island are scarcely as dense as those along the lower San Juan River, probably because of the longer and more clearly defined dry season. They also differ from the latter in the greater variety of valuable woods, but in other respects are like the forests at Castillo, of which a more detailed description is given below.

The comparative scarcity in these forests of sticks and logs,

favorite habitats of Slime-moulds and Fungi, and the consequent comparative scarcity of the forms of life with such habits is striking. This can perhaps be partly explained by the fact that Termites are exceedingly abundant and soon destroy all of the fallen softer woods which are most favorable to the growth of these low plant forms.

Ometépe is more thickly settled than any other section in which collections were made. With the exception of a short visit to Granada on the west shore of the lake, which was made by Mr. Smith for the purpose of purchasing needed supplies and hence resulted in but few additions to the collections, no other portion of Nicaragua in which well-travelled roads and numerous cultivated tracts occur was visited by the expedition. Hence the collections from this island show a proportionately larger number of cultivated and introduced plants than those from any other locality.

Climatic Conditions and their Effect.

The dry season usually begins on Ometépe in the early part of December and continues about six months, only occasional light showers falling during this period.

Of the 36 days, from the 5th of January to the 10th of February, which were spent on the island 20 are recorded as "clear and windy," 6 as "threatening, and cloudy during part of the day," and 10 show some rainfall. Of the latter only four were really rainy days, the remaining six having but light showers after which the day was again "clear and windy." None of the rains were more than ordinary summer showers.

The wind is almost constantly from the north-east, the North-East Trade often being a gale.

The temperature ranges from about 70° to 90° Fahr.

During January the vegetation on the island was luxuriant, and showed no effects of the dry season. Most of the Phanerogams flowered during this month, and were at their best during the first three weeks.

Toward the close of January and in February the general

appearance of the vegetation changed. Fruits appeared in place of the more showy flowers, the leaves of many plants began to fade and fall, and a thick coat of volcanic dust replaced the freshness of the earlier vegetation, all this giving the landscape a gray and barren appearance.

The advantages and disadvantages which the period spent on the island offers to the collector may be summed up as follows: *Phanerogamia* were at their best in flower during the first half, and in fruit during the latter part of this period.

The entire period was good for *Pyrenomycetes*, *Polyporeæ*, etc., and Ferns among plants, and for terrestrial Molluscs among animals. It was fair for Slime-moulds (which probably appear to better advantage later in the season); too late for Agarics, etc., which evidently thrive better during the rainy season; and rather early for aquatic Molluscs and most Insects.

The almost entire absence of Parasitic Fungi on leaves was striking.

On the whole the months of December and January are the best for the botanist.

Method of Work and Results.

As this was the first practical experience in tropical parts which both Mr. Smith and the writer had, no division of labor was made, but both collected and studied all accessible plant-forms for the purpose of gaining a general knowledge of the flora.

Collecting trips were made on foot, on horseback, or by canoe, and when necessary native help was secured. For the most part only short trips were taken, the greater part of the time being given to the study and preparation of material obtained within a mile from Moyogalpa.

Notwithstanding this fact so much material was accumulated that in order that it might be properly studied and cared for it was necessary to work late into the hours of the night, much to the surprise of the natives, whose "working day" is

from 6 A.M. until 12 M., and who could see neither reason nor advantage in crowding two days into one.

The study and preparation of the material required more than twice as much time as the field-work. Where it was possible a good series of each species of the Phanerogams and Ferns was collected, and each species was numbered and described from the fresh specimens. Seeds and fruits of most of the species were also collected. These were dried and packed in boxes or paper. The Fungi, Slime-moulds, etc., were dried, and either glued in small boxes which had been brought for the purpose, or, when not friable, they were simply wrapped in paper.

The specimens were then packed in wooden boxes which were lined with oil-cloth to exclude moisture. This method of packing proved very satisfactory, the specimens passing safely through the ordeal at Castillo, Greytown and on board the ship.

A number of obstacles interfered with the work to a greater or less extent: the poor, narrow quarters, infested with numerous insect-pests, scorpions, rats, etc., not only caused personal discomfort, but increased the difficulties of preparing the material and saving it intact.

The suspicion with which the natives at first viewed the work of the expedition also contributed somewhat in the same direction, the use of a more comfortable hut being refused the party for this reason, and other minor evidences of distrust being apparent. Later however many of the natives became somewhat interested in the work, which was a source of constant speculation to them, some thinking that the specimens were to be used for medicines, others that they were to serve as patterns for calico-prints, etc.

Insects, particularly ants which swarm in countless numbers everywhere, freely attacked specimens when these were not protected by naphthaline or camphor, and a vigorous warfare had to be waged against them.

The frequent high winds, and occasional showers, also in-

creased the difficulty of caring for the material, as it was necessary to dry much of it in the open air, while the boldness of various domestic animals and the simple curiosity of the natives likewise proved annoying at times.

The collections which were brought from the island may be summarized as follows:

Phanerogamia—300 species, represented by about 2,000 specimens. In addition to these the dried seeds and fruits of more than 200 of the species were taken.

Filices—18 species represented by numerous specimens.

Musci—only a few specimens and species.

Polyporeæ—about 25 species and numerous specimens.

Pyrenomycetes—about 20 species represented by numerous specimens.

Specimens of a number of other species of Fungi were also collected.

Myxomycetes—numerous specimens belonging to 15 species.

In addition to these about 100 species of *Coleoptera*, 30 species of *Mollusca*, and a few specimens representing other groups, were taken from the island.

The profitable, and for that reason pleasant, sojourn on Ometépe was terminated February 10th, when the party left for Castillo Viejo by way of Ft. San Carlos.

SAN CARLOS.

Three visits in all were made to San Carlos, and while only a short stop was made during each of these, and comparatively few additions were made to the collections, the point offers certain advantages to the collector a brief discussion of which may be of interest.

San Carlos, village and fort, is located on a somewhat elevated ridge which forms a rather narrow point running out between the left bank of the San Juan River and Lake Nicaragua, at the outlet of the lake. On either side the ridge slopes somewhat irregularly to the swamps which here line

the shores of both river and lake, those along the river being broader and of greater extent. On the side toward the interior of the mainland the heavy forests, which evidently once covered the entire ridge, have been cleared away for some distance to facilitate the defense of this important point in war.

For several miles below San Carlos the shores of the San Juan are low and swampy, and directly opposite and below these marshes are very broad, and extend for several miles along the south-east shore of the lake. Through these extensive marshy flats, which are made up of the silt brought down by its own floods, the Rio Frio, a large stream having its source in the distant mountains of Costa Rica, empties into the lake from the south-east. Inasmuch as the San Juan flows from the lake in almost exactly the opposite direction the two streams are nearly parallel for some distance, and near the lake are separated only by a narrow swampy spit. These streams are engaged in a constant struggle for mastery, the Rio Frio persistently striving to close up the outlet of the lake, and the San Juan equally persistently cutting its way through the banks and bars of fine mud. The result is a gradual filling up of the lake on this side, and unless the Rio Frio is turned from its course (as it probably will be when the great canal is completed) the lake shore will ultimately recede from San Carlos leaving it an inland point.

Because of the character of the surrounding country San Carlos is an excellent locality for various swamp-species, but for deep-forest collecting it is inferior to all the points along the lower San Juan. It is an important locality to the collector however because it is from here alone that he can make excursions up the Rio Frio, along the east shore of the lake, or across the lake to the more densely populated districts beyond.

Three stops in all were made at San Carlos: the first from December 31st to January 5th, the second on the 11th of February, and the third on a special trip made by the writer from Castillo Viejo, March 12th.

The first of these visits was made soon after the opening of

the dry season. The water in the lake, the river, and the swamps was still at its maximum, and the surrounding country was verdant with the vegetation whose vigor had not yet been diminished by the dry season. During this time *Phanerogamia* could have been collected to the best advantage, since here as elsewhere they were found to be in the best condition early in the dry season.

Before the second visit the waters of the lake had receded, the swamps were becoming drier, and the evidences of a dry season were more numerous.

The third visit brought out these characteristic changes still more distinctly. Slime-moulds and numerous Molluscs were collected on the mud-flats which were now exposed and quite firm, many of the trees and shrubs were losing their leaves, birds were congregating in flocks preparatory to their Spring migrations to northern countries, and all in all, though the conditions were in some respects exactly reversed, one was reminded of Spring in the Mississippi Valley.

Because of the short stay made during each of these visits only about 35 species of *Phanerogamia* were collected. Beside these a number of species of Fungi, Slime-moulds, Molluscs, Beetles, *Orthoptera*, etc., were added to the collection.

Thorough, systematic work in this vicinity would however without doubt yield rich returns to the student and collector.

CASTILLO VIEJO.

After waiting one day at San Carlos for the river steamer, the party continued its journey down the San Juan River to Castillo Viejo, and reached the latter point on the 12th of February. After securing comfortable quarters above the office in the Canal Company's building, the writer made a three days' flying visit to Greytown for the purpose of purchasing additional supplies, while Mr. Smith secured two rooms in a native's house for a workshop, and made other necessary arrangements for work.

Castillo Viejo is the first Nicaraguan port of entry on the south-eastern or Greytown side, Greytown, or as it should be called San Juan del Norte the Nicaraguan government recognizing no other name, being a free port, and hence it was expected that there would be trouble in passing some of the supplies both on the first trip up the river, and on the return from Greytown, but on both occasions the Collector of Customs admitted the supplies free of duty, for which kindness and many other subsequent ones, the party was largely indebted to the efforts of Mr. E. F. Harris, the Company's agent at Castillo Viejo.

Surface Features.

The old fort, Castillo Viejo, or as it is commonly called, Castillo, is situated on a rounded hill which commands the San Juan River at the Castillo Rapids about 35 miles below San Carlos, and at the foot of which, on the right bank of the river, winds the single street of the village of the same name.

The hill on which the fort stands is cleared of all coarser vegetation, as are the hills and narrow river-valley in the immediate vicinity. There are but few clearings other than these for miles around. An occasional small plantation or a cattle-ranch, is all that breaks the brilliant monotony of the dense tropical forest which almost undisturbed here flourishes in all its pristine glory.

The vicinity of Castillo is quite hilly, the hills on both sides hemming the San Juan River in its narrow valley which is more or less swampy near the village. These hills are mostly separated by deep ravines the bottoms of which frequently show exposures of rock, which is evidently volcanic in its origin, over which dance the clear waters of pretty little streams whose banks are lined with ferns, and overhung with masses of vines and other plants.

With the exception of the few clearings heretofore noted the entire region is covered with typical tropical forests. These forests are almost impenetrable, except with the aid of the

machete, a long knife, with which the traveller must literally tunnel his way in many places through the walls of vegetation. The trees, many of which are very tall and 8 to 14 feet in diameter, are scarcely as closely placed together as are those in our northern forests, but the intervening spaces are crowded with shrubs, and vines, and numerous other plants so that, particularly in lower places, dense jungles are formed. Moreover each tree is a veritable garden in itself. The masses of parasites and epiphytes which cover the larger branches of the trees, and often extend down the trunk and along the smaller branches to their very tips, form a perfect canopy overhead through which the sun's rays never penetrate. Ferns, Bromelias, Orchids, Mosses, and many other plants crowd their hosts with a dense mass of multi-colored vegetation. In their active struggle for existence with their more powerful neighbors of the forest these plants have probably gradually ascended, in their search for the sun's light, to the upper branches of the very neighbors who sought to crowd them out, thus transferring the struggle from the surface of the soil to the air above. So firmly is this habit fixed however, that even where a tree stands alone its trunk and branches are almost invariably covered with these plants. Their abundance and variety may be judged from the fact that upon a single "Jicara-tree," not over 20 feet high, which stood in a clearing near Castillo, the writer counted 40 species of epiphytes, mostly Ferns, Orchids, and Bromelias.

On some of the higher grounds the vines, which in the lower jungles hang in such profusion from every limb, and the underbrush which with these renders progress so difficult to the traveller, are less abundant at least near the ground, and hence it is possible for one to move about more freely, the underbrush being in reality placed overhead, for the number of epiphytes remains undiminished even in places of this kind.

But whether the locality is high or low, the same deep, dark, reeking forest, whose profound silence is scarely broken

except by the dripping of the water from the dome of vegetation overhead, spreads over all. No roads cut its compact mass, and only the paths of the hunter or rubber-poacher serve to guide, or more frequently to confuse, the bewildered traveller. It is folly to enter these forests without a guide or a compass, the safest and most pleasant mode of travel, where it is possible, being by canoe along the numerous water-courses.

Two facts strike the observer as peculiar, at least during the season which the party spent at Castillo, namely, the comparative scarcity of brilliant flowers, and the failure of plants of one species to mass together. The comparatively small number of conspicuous flowers is a disappointment to him who expects to find a mass of brilliant bloom in these tropical forests, not so much because these flowers are really wanting, but because the flowering period of most of the species is rather long, and comparatively few flowers appear at any one time, and for the further, and perhaps more important reason that the flowers which do appear seem insignificant when compared with the sea of green which covers everything.

No less striking is the fact that as a rule specimens of any one species do not mass together to the exclusion of other species, excepting sometimes along the water-courses, particularly in swampy places. Different kinds of trees are mingled together in endless confusion, and no "groves" of any one species, such as those with which we are familiar in the North, occur, nor can any species as a rule even be said to predominate. The same is true of smaller plants, and the collector is not only often bewildered by the variety of plants which comes in his way even in a restricted locality, but is also provoked by the scarcity of specimens of most of the species. Along the low river-valleys however this is not true, for often palms, grasses, etc., take possession of large tracts, the rivers no doubt facilitating the distribution of their seeds during overflows.

The same scarcity of old sticks and logs suitable to the growth of Slime-moulds, etc., which was noticeable on Ome-

tépe is apparent here, both Termites and the excessive moisture no doubt hastening their decomposition.

Inasmuch as numerous specimens were collected along the La Juana and Los Sabalos rivers, and hence these names frequently occur in the locality lists, a brief description of the streams may be desirable.

The *La Juana River* is a small tributary which empties into the San Juan from the north about one mile below Castillo. It is navigable by canoes for less than two miles from its mouth, and along this portion its valley is a rather wide, high (i. e. not swampy) river-bottom, the hills nowhere approaching to the banks, which are mostly muddy. Its valley is covered with dense jungles, its waters literally flowing between high walls of vegetation. Numerous trees lean out from the banks, and from their branches hang great festoons of vines, which often meet and form an archway over the dark, sluggish stream.

The *Los Sabalos River* empties into the San Juan about 12 miles above Castillo. Like the La Juana it flows from the north, but it is a much larger stream, and near the mouth is very deep. A short distance from its mouth the hills approach quite to the water's edge, and in the five miles of its course which were explored the river valley is quite narrow, and the banks are muddy, or rocky. The adjacent hills, so far as could be judged, are similar in their vegetation to those near Castillo, and the jungles of the river-valley are even more dense than those along the La Juana, being occasionally broken however by a banana-plantation or a cattle-ranch.

The largest of these, the cattle-hacienda "Los Sabalos" situated at the mouth of the river, is the property of Captain John S. Augustine, of the river-steamer "Managua," to whom the party is indebted for much valuable information, and many other courtesies. On this ranch, on the low bottom-land only a short distance from the mouth of the Los Sabalos, is found an interesting warm spring whose waters seem to be impregnated with sulphur, and in which were collected numerous

specimens of a small fresh-water Prosobranchiate Mollusc, probably *Potamopyrgus*, and several small fishes, etc. Only one trip was made to the Los Sabalos, namely on the 1st of March, 1893, the journey to its mouth being made by steamer, and beyond that by canoe. The return trip to Castillo was made by canoe on the San Juan River.

The collections along both the La Juana and Los Sabalos were made along the banks in close proximity to the water, neither time nor circumstances permitting an exploration of the deep forests beyond.

Climatic Conditions and their Effect.

In the vicinity of Castillo the dry season begins much later than it does at Ometépe, nor is it as sharply defined. It usually begins about the end of January, but this year it was delayed so that the end of February passed before it fairly set in. This gave the party a slight taste of the rainy season at its close, and suggested the difficulties which the naturalist would encounter when this season is at its height.

Of the 41 days, from February 12th to March 23rd, which were spent in Castillo and vicinity, 21 were more or less rainy, 4 were cloudy, and 16 were clear. Of the 21 rainy days 7 were quite stormy, while only light showers fell during the remaining fourteen days. Of the 16 clear days, 11 occurred in March, which was decidedly drier than February. The dews and morning fogs were heavy during this period, and the atmosphere was very humid.

The North-east Trade-wind was felt daily. It usually commenced to blow at about 10 o'clock A.M., and continued until evening, the nights and mornings being calm.

The range of temperature was about the same as on Ometèpe. The days were very warm, and the nights quite cool, particularly toward morning when heavy blankets were always acceptable.

No diminution in the freshness and vigor of the vegetation was observable up to the time of leaving Castillo, though no

doubt as the dry season advances many changes take place. Still it is said that at no time does it become as dry in this vicinity as it does in the western or interior portions of the country, and that the forests do not lose at any time much of the character described above.

The period spent at Castillo proved good for most *Phanerogamia*, the Ferns, Mosses, *Polyporeæ*, and *Pyrenomycetes*, too early evidently for Orchids and Slime-moulds, and probably too late for Agarics and other Fungi. The absence of leaf-parasites was again noticeable.

Method of Work and Results.

Essentially the same method of collecting, studying, marking, and packing plants that was employed on Ometépe was followed at Castillo, but to facilitate work a division of labor was made, Mr. Smith collecting and studying Fungi, while the writer gave his attention to the *Phanerogamia*, Ferns, Mosses, and Slime-moulds. Excursions were made on foot and by canoe, these being the only possible modes of travel since there are no roads in the vicinity of Castillo, and hence horses cannot be used. In the work of collecting, preparing material, etc., a native hunter, who was regularly employed by the party as a guide and factotum, proved of much assistance.

The abundance and variety of the local flora is so great that no difficulty was experienced in collecting plenty of material; in fact it was impossible to properly care for all that was obtained, partly because of its great abundance, and also because of the ravages of ants and other insects, but principally because of the prevalence of mould. Mould was found everywhere. Scarcely an object was free from it, the moist atmosphere rendering almost any surface a fit nursery for its development, but when this natural humidity was reinforced by the moisture belonging to a plant the result was truly astonishing. Plants which were put into press were covered with the delicate hyphæ and tiny sporangia in a few hours; the driers were soon so laden with spores that they could not be used

until they had been washed with alcohol and dried in the sun; seeds and fruits, Fungi and other specimens which were exposed for the purpose of drying were soon lost in the dense coat of mould, and this was true not only of the fresh material which was collected at Castillo, but also of many of the Ometépe specimens which had not been permanently packed in the hurry of leaving the island. Indeed it seemed for a time as if the fruits of several weeks' labor were to be lost, but the specimens were finally saved by thorough washing in alcohol by which the spores and hyphæ of the mould were destroyed. The alcohol was applied mostly with a small bulb-pipette, and the specimens were again dried. Many of the pressed plants were treated in this way three or four times, which necessitated the handling of each one six or eight times oftener than would otherwise have been the case.

The last 18 days at Castillo were given entirely to such overhauling of the material, and to packing, much of the work being done on improvised tables in the open air on the leeward side of the work-shop under the direct rays of the tropical sun, this being the only possible method of thoroughly drying the specimens with the facilities at hand. At times the struggle seemed almost hopeless, but it may be well to remark here that the material finally reached Iowa City in good condition, neither the mould nor the alcohol affecting the specimens to any appreciable extent.

As the first 6 days at Castillo were non-productive because of heavy rains, and the last 18 were devoted to the struggle with the mould, and to packing, only 17 days remained for active field-work and study. This, coupled with the fact that some specimens of Phanerogams and a few Ferns were ruined in press by the mould and moisture, accounts for the comparatively small number of pressed specimens from this locality. The latter portion of the collecting period was consumed by the writer principally in collecting Ferns as it would have been impossible in the short allotted time to care for all the plants which could have been obtained.

The collection from Castillo and vicinity consists of the following material:

Phanerogamia—165 additional species, and 75 of the species collected on Ometépe, all represented by about 600 specimens. The seeds and fruits of many of these were also collected.

Filices—60 species represented by about 600 specimens.

Musci and *Hepaticæ*—about 20 species, each represented by several specimens.

Polyporeæ—numerous specimens of about 100 species.

Agaricineæ—about 50 species; Mr. Smith obtained and preserved the spores of a considerable number of these and other *Hymenomycetes*.

Pyrenomycetes—about 35 additional species, and numerous specimens.

Myxomycetes—16 species in all, of which 10 were not found on Ometépe.

A number of species of *Discomycetes*, *Lichenes*, etc., was also added.

Comparatively few zoölogical specimens were collected. A few species of *Coleoptera*, *Orthoptera*, *Mollusca*, and straggling representatives of other groups were incidentally picked up, but no systematic effort to obtain material of this kind was made. It is needless to say that this locality was not exhausted, and that the party left Castillo with feelings of regret that so much unfinished work must remain behind.

On the 23rd of March the party resumed the journey down the river San Juan to its mouth, this time being compelled to go by way of the Colorado branch on account of the low stage of water in the old San Juan bed. The trip from the mouth of the Colorado branch to Greytown was made by steamer on the open sea.

THE SAN JUAN VALLEY.

While portions of the San Juan valley have already been described in the preceding account, a few additional notes may

be of interest. From San Carlos to the mouth of the Los Sabalos River, a distance of over 20 miles, the river valley is broad and low, in most places swampy, and the river is comparatively sluggish—in fact it is here but an estuary of the lake. That the lake itself once extended much further east seems certain. The fact, already noted, that the Rio Frio is now crowding the lake shore westward indicates this, and an additional bit of evidence was obtained by the writer on the last trip from Castillo to San Carlos. This is a shell-bank on the cattle-ranch of Manuel Vargas on the right bank of the San Juan River about 12 miles below San Carlos. The river here flows almost due east, and has cut away a portion of the shell-bearing stratum, thus forming an almost vertical bank which, in the portion under consideration, varies from 12 to 15 feet in height, the general surface gradually rising from this toward the south and south-west. For a distance of about 100 yards this bank is literally packed from top to bottom with the shells of two small species of *Unio* (species not yet determined), many of them being cemented together and imbedded in calcareous tufa. The shell-deposit extends southward from the river-bank for an unknown distance; it was traced back by the writer for at least 50 yards, but as he was not provided with the necessary implements for making excavations, the limit could not be ascertained. Many of the shells were found in their natural vertical position, and many more were still united by the ligament, all this, coupled with the fact that the species are now living in abundance in both the river and lake, indicating that the shells were deposited *in situ*. The facts noted above indicate that the deposit was formed by ordinary natural methods, but it is only fair to state that sharp chips of flint, rude and probably merely accidental fragments, are associated with these shells. However no other evidence (if this may be considered evidence) that the deposit was formed by other than ordinary means was found, and until stronger evidence is secured we must look upon it not as a *shell-mound* but an ordinary geological stratum. It

is probable that at one time the lake extended over this portion of the river-valley, and that its waters were at least 12 or 15 feet higher than at present before the river had cut down to its present bed through the barrier near or below the mouth of the Los Sabalos River.

Below the Los Sabalos the San Juan River is much more rapid, and a number of rapids, of which those at Castillo are the most formidable, offer a serious impediment to navigation during the dry season. From the Los Sabalos River to Castillo the river valley is quite narrow, the low rounded hills approaching close to the river. Below Castillo to the Machuca Rapids, a distance of about 15 miles, the river valley is somewhat broader, the hills being mostly rather low and only in some places approaching the river. For a short distance below Machuca on the Costa Rica side the hills are close to the river, and higher, some of them probably reaching 500 feet in height. Beyond this and continuing about 25 miles to Ochoa, the proposed site of the great dam by which the waters of the San Juan are to be brought to a level with the lake, the course of the river lies between low hills which alternately approach the river on either side, those on the Costa Rica side being rather higher and more numerous. Below Ochoa the river is wider and contains more islands, and its valley becomes broader and flatter and in many places is swampy, particularly below Colorado Junction, the point at which the greater part of the water in the river leaves the San Juan river-bed and forms the Colorado branch. This point is over 30 miles below Ochoa, and about 20 miles above the mouth of the Colorado. Both the old San Juan branch and the Colorado branch flow through low swamps which extend from Colorado Junction to the sea, and which are uniformly covered with an inextricable tangle of tropical vegetation.

The San Juan valley, with the adjacent country, forms a great depression which cuts the Cordillera, "the back-bone of the continent," and widely separates the segments, the moun-

tains nowhere approaching the river. Mountainous country may however be reached by following any of the larger tributaries of the San Juan, particularly on the Costa Rica side.

The bed of the San Juan is mostly muddy in its upper course above the Toro Rapids, rocky in the middle portions, and sandy below. The hills and valley are everywhere covered with vegetation of the same character as that at Castillo, though almost no large trees are found along the river below Ochoa, the vegetation in this part forming low tangles. Numerous species of palms predominate, particularly on the lowlands, and their great feathery leaves, often 45 feet in length, sometimes line the shore for miles. The same bewildering mass of vegetation however greets the eyes of the naturalist everywhere, and causes him to long for more time and better opportunities to delve more deeply into the matchless riches which Nature has so lavishly bestowed upon this long-known and yet comparatively unexplored region.

The San Juan valley is rather sparsely settled. Comparatively few plantations are found along the river, and Castillo is the only village between Greytown and San Carlos. There is consequently but little change in the natural features of the country, and the ambitious naturalist would find it well worth the time and trouble to fully investigate this region which still retains its virgin purity untainted by civilization.

SAN JUAN DEL NORTE.

San Juan del Norte, or Greytown, was reached in the evening on the 24th of March, after a two days' voyage from Castillo. As no steamer was to leave for Bluefields until the 2nd or 3rd of April the party again located at the Canal Construction Company's headquarters in America, two miles north of Greytown. The first two days were spent in making observations on the great canal, and in studying local plants and collecting Molluscs and Insects.

Greytown is located at the mouth of the San Juan River on the left bank of the San Juan branch. Its immediate vicinity,

particularly along the coast, is sandy, and the town is closely hedged in by a great jungle-covered swamp.

The so-called dry season begins in January and continues until May, but rains are frequent during this period, as the moisture-laden North-east Trades constantly sweep over the region from the sea, and consequently there is no such marked change in the appearance of the vegetation as was noticed on Ometépe.

The fact that Greytown is the only port on the south-eastern coast of Nicaragua, and that it is surrounded by an almost unexplored region of unusual interest to the naturalist, makes it an exceptionally important point, especially to the botanist who would visit this portion of the continent.

Through the kindness of Mr. Frank P. Davis, Chief Engineer of the Canal Construction Company, who, with his associate officers, did so much to promote the success of the expedition and whose many favors will be long remembered by the recipients, the party was enabled to visit the Divide, the ridge about 16 miles distant from Greytown through which the deepest cut along the route of the proposed canal is to be made. The party left Greytown on the morning of March 27th, and travelled by hand-car along the railway, which crosses the great swamp west of Greytown, to Camp Seven, a distance of 12 miles, thence along the Deseado River by canoe to Camp Menocal, a distance along the river of about 4 miles, at which point the night was spent. On the following day the journey was continued on foot along the Deseado River by slippery paths through dense jungles to the Divide, a distance (as the party was compelled to travel) of about 5 miles.

Of the region traversed the immediate vicinity of Greytown is sandy; the portion from Greytown to a point near Camp Seven is, as has already been stated, a great swamp which is now cut by the railroad built by the Canal Construction Company for the transfer of supplies and material needed in the construction of the canal. Beyond Camp Seven the country

becomes more rolling except immediately along the Deseado River. This stream is small and winding, and filled with numerous snags so that progress by canoe was exceedingly slow, the boatmen often being compelled to get into the water and push or drag the canoe over logs and shallows. In the character of the vegetation lining its banks this stream does not differ materially from the La Juana, already described. Its banks are rather high and mostly nearly vertical, and its bottom is sandy or muddy.

For some distance beyond Camp Menocal the character of the country remains unchanged, but as the Divide is approached the country becomes much rougher, the paths become more nearly vertical, and travel is more difficult. Near the Divide the Deseado, here scarcely more than a large brook, dashes over ledges of rock forming two beautiful waterfalls, the Saltos Louisa and the Saltos Laura. Between and below these falls the stream flows through a deep canon or ravine whose sides are covered with a splendid carpet of luxuriant vegetation, the whole forming a charming picture. This valley is to form a portion of the proposed canal, and it is indeed a pity to ruin this beautiful picture even by such a magnificent undertaking. The return to Camp Menocal was made in the afternoon of the same day through a heavy rain which equally soaked the clothing and dampened the spirits of the party. The night was again spent at Camp Menocal and on the following morning the trip to Camp Seven was made on foot by a shorter route across country; the return to Greytown was made by hand-car.

Notwithstanding the heavy rains the trip was very profitable. As it was evident that it would be impossible to care for much material which required pressing, but few Phanerogams were collected, namely about 20 species, the principal attention being given to Ferns of which about 30 species were added to the list. The pressed specimens which were collected at Greytown and vicinity were subsequently dried on board the steamer which carried the party from Bluefields

to New Orleans. A few Fungi, seeds and fruits of Phanerogamia, and alcoholic specimens of various plant-tissues were collected. A number of Orthoptera, Beetles, Reptiles, Batrachians, etc., were added to the zoölogical collection.

The region between Greytown and the Divide would, if properly explored, yield an abundance of valuable material. Many species which are not found on the upper San Juan appear here in abundance. The variety of Palms and Ferns is much greater, and many other forms, not seen in the interior, occur. The superficial observations made in the vicinity of Greytown showed 45 Phanerogams and 12 Ferns identical with species which were found at Castillo. The great humidity of the atmosphere, coupled with the fact that there is no very well defined dry season, is productive of greater luxuriance in vegetation, but it also interferes seriously with the preparation of material. This difficulty, however, could no doubt be largely obviated, here as well as in the interior, by using a portable oil-stove with a sheet-iron oven. As kerosene-oil is generally used, and can be obtained almost anywhere in the country, this would be practicable, particularly as the oven could also be made with handles and of such shape, size and strength as to be serviceable as a trunk or packing-box.

The return to Greytown from Camp Menocal was made on the 29th of March, and the remaining days, until the 3rd of April, were given to the care of material already collected, to local study, sight-seeing, packing, etc.

On this as well as on the two former visits to Greytown, the members of the party received much important information and many valuable suggestions and other aid from the following gentlemen: Chief Engineer Frank P. Davis, Mr. E. U. Hunt, Mr. Crowninshield, Mr. H.V. Mielly, Dr. De Soto, Mr. Ehle,—all officers of the Canal Construction Company; the American Consul at Greytown, Mr. Braida, and the Vice-Consul, Mr. Von Phul; Mr. Walter Ingalls and others.

MISCELLANEOUS NOTES.

Zoölogy.

While the expedition was mainly a botanical one, a number of zoölogical specimens were secured, and a few observations were made which may be of interest.

A disappointment was experienced in the comparative scarcity of animal life in the jungles, the deep and oppressive silence of which has already been alluded to. It is true that in the deep forests one may occasionally come upon a band of Howling Monkeys which make the woods resound with their hoarse cries, or a parrot flying overhead may break the profound silence with its harsh chatter, but after all, these are exceptions, and one may often spend hours in these forests and scarcely hear a sound of any living thing. To find the numerous chattering, noisy, gaudy representatives of animal life, and for that matter the brightly colored representatives of the plant kingdom, which are generally associated with the tropics by the uninitiated, one must go to the more settled districts, to the edges of the forests, to the vicinity of villages and plantations. There, close to the habitations of man, one will usually find the representatives of various animal groups more numerous, and more striking than in the deepest, purest virgin forests.

A few brief notes on various groups of animals represented in southern Nicaragua, on which observations were made, are here presented:

Mammalia.—But little attention was given to this class, and but one specimen, the head and vocal apparatus of the Howling Monkey, was brought. On Ometépe two rather common species of Monkeys, a small Deer, a *Lepus*, and a *Sciurus* were the only Mammals observed, and along the lower San Juan an additional species of Monkey, a Peccary, and a Tapir were seen. The cries of other species were heard in the forests at night, but no effort was made to trace them.

Aves.—This class was likewise neglected, no specimens

being collected. Birds were quite abundant in the vicinity of Moyogalpa, and at San Carlos where water and swamp species were abundant, but farther down the river and away from its immediate shores comparatively few appeared, and these skulked about singly or in pairs in the dense woods or among the jungles which line the smaller tributaries. A few species were found nesting at all the points which were visited, but the nests were not disturbed.

Reptilia.—Only three species of venomous snakes occur, and specimens of all these were secured. The species are: the Coral Snake, and the two species called by the natives the Tomagog, and the Toboba, as nearly as the writer could get the names. The first of these was the only one found on Ometépe; it is not common, and is sluggish and not at all vicious. The second species is generally found on or near the plantations, and the third, perhaps the most savage and deadly of all, occurs in the woods most commonly. Fortunately for the traveller they are nocturnal in their habits, and quite lazy, but one must be careful not to plunge his hand carelessly into any dense clump of vegetation, as it is in such places that these snakes spend the day.

A number of harmless species were observed, but none were collected on Ometépe because of the scarcity of alcohol. A small Boa, which had been engaged in catching rats was killed on Mr. Smith's cot in Moyogalpa, and was sadly missed soon after when the rats took possession of the room. A very few specimens were collected along the San Juan, and but few were seen.

Lizards are exceedingly common everywhere and several species were taken. It was nothing uncommon to hear the Iguana plunge into the water from some overhanging treetop, or go crashing through the underbrush when disturbed. Small lizards are particularly plentiful, especially in and about houses, and it is an ordinary sight to see a number of these graceful little fellows gliding up and down the walls, and over tables and other objects in the room. Alligators are also very

common, and their awkward bodies may frequently be seen on the mud-flats along the shores of both lake and river, or floating like so many logs among the waves of the lake.

Batrachia.—A number of species belonging to the Order *Anura* were collected; they seemed to be most common in the low forests along the San Juan River, and some very brightly colored species were taken.

Pisces.—The waters of eastern Nicaragua abound in fishes, but only a few small species were taken. The occurrence of Sharks in these fresh waters is interesting. They are found in abundance both in the lake and in the San Juan River, and are said to be man-eaters. A shark was reported to have been caught at San Carlos, a short time before the second visit of the party, with the remains of a human body in its stomach; also, when during the stay at Castillo, a little child fell into the Rapids the natives fished for sharks with long lines in the hope of securing at least the fragments of the unfortunate little one.

Arthropoda.—A few *Crustacea*, all belonging to the Order *Thoracostraca* were collected. Crabs are found in both the lake and river, and one or two terrestrial species were found above Camp Menocal.

Of the *Arachnida* Scorpions and Ticks are common; the former are particularly so, and often find their way into houses where they have a habit of hiding in one's shoes and clothing. A number were collected. Ticks are common in the woods during the dry season, and are said to be very troublesome at times. Spiders were not rare but none were collected. An interesting species of this group, which probably belongs to *Phalangium*, occurs in the woods on Ometépe in great numbers, and often collects in clusters a foot or more in diameter.

Insects were scarcely as common as they were expected to be, yet a number were collected. About 30 species of *Orthoptera*, principally from Ometépe, Castillo and Greytown, were taken and at once forwarded to Prof. Lawrence Bruner, of Lincoln, Nebraska, who will report on them. Of *Coleopte-*

ra about 175 species were collected, mostly on Ometépe, and have been referred to Mr. Wickham, who will report on them. No doubt a sweeping net would have greatly increased the number of species and specimens, but it is well to remember that this and all other zoölogical collecting was subordinate to the botanical work, and was purely incidental. *Hemiptera* and *Diptera* were not common and none were collected. *Lepidoptera* were abundant on Ometépe, but no collections were made. They probably become more plentiful along the river as the dry season advances. *Hymenoptera*, especially Ants, were everywhere very plentiful, both in the number of species and individuals. The description of the curious architecture and remarkable habits of many of the species would form a volume in itself, and cannot be undertaken by those whose attention was directed to other work. Several species of stinging ants make life a burden to the collector, and the sting of the alligator ant, a species nearly an inch in length, is said to often produce a fever; the writer was stung in the fore-finger by one of these ants, and the finger remained paralyzed for nearly two hours.

Mollusca.—About 35 species of *Mollusca* were collected on Ometépe, at San Carlos, and at Castillo. Terrestrial molluscs were rare along the San Juan, and of the fresh-water forms but few were taken as the water had not fallen sufficiently to enable the party to collect these without dredging apparatus.

Reports upon all of the groups in which collections were made will be presented in this Bulletin as soon as the material in the respective groups is worked up.

Healthfulness.

The safety with which the naturalist may venture into a region which is new to him is always a matter of much concern. The eastern coast of Mexico and Central America has an unsavory reputation as to healthfulness, but however true this may be of some portions of this coast, it is safe to say that, so far as the region visited by the expedition is con-

cerned, a little attention to hygiene will render one's health quite as secure as in most of our northern states.

The traveller in these tropical regions should invariably provide himself with flannel underclothing; aside from this the clothing should be light, airy, and strong if he is to do much travelling in the jungles. In case of a wetting, which is not unusual in this region, the wet clothing should always be removed as soon as possible, and a cup of hot tea or other drink taken. Hard work in the hot sun is dangerous, and excessive exercise should be avoided. Plenty of sleep, bodily cleanliness, close attention to the digestion, and care as to the kind of water used for drinking purposes, will usually secure immunity from fevers and other diseases which attack those who are careless in these matters.

Sickness often prevails among the natives, but it is not due so much to the climate as it is to their own carelessness, for in their homes they are not cleanly, living in blissful companionship with their domestic animals; they are careless about food, and their drinking water is usually taken from the lake or rivers in places which serve as general dumping grounds for offal, or as bathing places for both man and beast. At Moyogalpa the water was at times very filthy, and the party found it necessary to boil it before using. This should always be done until one becomes accustomed to the water even where this is taken from clear streams. A good plan, if one is stopping at one place for any length of time, is to collect rain-water for drinking purposes.

Liquor as a beverage should be avoided. The climate is in itself sufficiently enervating, and the habitual use of alcohol soon wrecks the best constitution. Those who drink to keep off fevers soon find that they have exposed themselves to a much greater danger.

The damp night air should be avoided, and warm blankets should always be carried, as the nights are often quite cold. A small medicine-chest should not be forgotten. This should contain remedies for disorders of the digestive system, for

fevers, and for diseases which are likely to attack the weakest point in the constitution of the would-be traveller.

Supplies.

Clothing, mosquito-bars (so essential in this region), umbrellas, blankets, oil-cloth, lanterns, paper, twine, small tools, such as saws, hatchets, files, etc., can be purchased at reasonable prices at Greytown, Bluefields, or Boca del Rama. Large packing-boxes, oil, and minor supplies can be obtained in almost every village. Alcohol can be purchased at Greytown and Bluefields for about 55 or 60 cents, gold, per gallon, but it cannot be taken into the interior of Nicaragua without a special permit from the government, which is also required if the traveller desires to carry a rifle or other arms of precision. Side arms are admitted without hindrance.

It is safest for the collector to carry small paste-board boxes, vials, and other small receptacles for specimens, as these are not easily obtained. Naphthaline, which is almost indispensable, and various reagents used in microscopic and other work should also be brought from home, nor should the collector forget the small articles necessary for the repairing of clothing, shoes, etc., as it is often impossible to get these when most needed. Metallic boxes, or other receptacles which permit absolutely no circulation of air, should not be used as the moisture condenses in these and often ruins the specimens. Paper is the best packing material, and if the larger packing boxes are lined with oil-cloth, and the specimens are put in when dry and the boxes are at once closed, the material may be transported with safety.

BLUEFIELDS RIVER.

The party left Greytown April 3rd for Bluefields, where a fruit steamer was to be taken for New Orleans, but upon arrival at Bluefields it was found that the steamer Gussie was to make a trip up the Bluefields River before leaving for New Orleans. Rather than wait at Bluefields, the party took

passage at once, and enjoyed a delightful sail to Boca del Rama. The valley of the Rio Escondido, or Bluefields River, is broad and low below Boca del Rama, and the river is lined with banana plantations on both sides. Back of these the valley is covered with dense jungles which would no doubt prove an excellent collecting ground. Near Boca del Rama a few rounded knobs appear, and beyond this the country is said to be rougher.

Boca del Rama is the first port of entry on Bluefields River, about 40 miles from its mouth, and being situated at the head of navigation for large vessels on this stream, and at the junction of the Rio Mico and Rama River, by either of which the interior may be reached, it is, next to Greytown, the most important point in eastern Nicaragua, at least for the naturalist.

But few specimens were taken on this trip, but the observations which were made indicate that a very profitable excursion could be made into the great forests of the interior of Nicaragua by this route. The mahogany camps in the interior would be particularly favorable both on account of the accommodations and the protection which they offer, and because the men are compelled to cut roads through the jungles, and travelling is thus made easier.

The party is indebted to Mr. Henry Brown, of Bluefields for an opportunity to examine his banana plantation "Mango," one of the finest on the river, and for other kind favors.

The Gussie returned to Bluefields Harbor in the morning of April 6th, and at 8 o'clock of the same morning the party bade farewell to Central America and set sail for "home and native land."

NICARAGUAN MXYOMYCETES.

By THOS. H. McBRIDE.

The species here listed or described are all from material collected in January and February, 1893, by members of the Nicaraguan Expedition, i. e., either by Mr. C. L. Smith or by Mr. B. Shimek. The difficulties of collection and preservation, owing to climatic conditions, were very great. Many species collected in good condition in the mountainous interior, were more or less seriously affected with mould as soon as they reached the humid atmosphere of Greytown. The specimens as soon as taken were fastened by thick glue to the bottoms of shallow but covered paper trays. But for this precaution it is doubtful whether a single Slime-mould would have made the journey from Nicaragua to Iowa. Many of the species are represented by rather scanty quantities of material but all herein described are in good condition for study, as our figures in the case of the new species plainly show.

Contrary to all expectation, the Nicaragua Slime-moulds, so far at least as may be determined from material now at hand, are strikingly like those of our northern United States. Of the twenty-five species collected nineteen are identical with those found commonly in eastern Iowa. Six only are new and these represent familiar genera. On the other hand, our most common genus *Trichia* is wholly unrepresented. This can hardly be an accident as the collection represents a wide area as to habitat, and the most favorable period of the year as regards season.

Iowa and Nicaragua are extremes as far as concerns climate and the Phanerogamic flora, ferns, larger plants generally are totally unlike; yet here are these minute saprophytic organisms substantially the same in both latitudes.

One explanation of the enigma probably lies in the fact that Slime-moulds are essentially plants of the summer season, flourishing in summer months the world around. The plasmodial phase thrives and grows in wet warm weather, but for fruiting a certain modicum of dry weather is necessary. In Iowa the alternations of moisture and drouth occur during the months from March to September inclusive, the later months being dry. Nicaragua differs from this only in that her wet and dry seasons in periods of about six months each fill up the entire year. Winter in our climate comes upon the Slime-moulds in fruit, i. e., in their dry condition when they experience little injury from our excessive cold. Too much wet in any case is not good, and it seems that certain parts of Nicaragua are for this reason almost destitute of Myxomycetous plants. The species common to both countries show in Iowa better types than in Nicaragua, and the best Nicaraguan specimens are from Ometépe where the dry season is most pronounced in character. From the number of species common to both latitudes we may also infer that Slime-moulds are after all well established organisms, little susceptible of any great variation. They have responded but feebly to changes of environment, and the forms they now wear are old.

The Nicaragua species of Myxomycetes as collected by Messrs. Shimek and Smith are as follows:

1. CLATHROPTYCHIUM RUGULOSUM *Wallroth.*

Typical. Collected at Ometépe by Mr. Shimek where it was comparatively common.

2. CRIBRARIA EXILIS *Macbride.* n. s. Plate X, Figs. 6 and *6a.*

Sporangia gregarious, very small but very long-stalked, nodding, spherical, purple-brown, not at all flattened above, the

calyx proper small, its ribs extended upwards *Dictydium*-like and connected at intervals by very delicate transverse bars which are also extremely regular. The net is comparatively limited, but well-formed with angular nodes connected with each other in all directions by delicate threads which form sometimes a network in the intervals of the larger net, no free ends; stipe very long about eight times the diameter of the sporangium borne on a small hypothallus and tapering very slightly upwards, purple by transmitted light; spores 5–6 μ, smooth, pale purple.

This species belongs to Rostafinski's genus *Heterodictyon*, a genus by Massee, properly I think, united with *Cribraria*. The present species is accordingly to be compared with *C. mirabilis* (Rost.) Mass. and *C. bieniazzii* (Racib.) Mass. From both these it is instantly distinguished by the color and great length of stem, as well as by all microscopic characters.

Collected by Mr. Shimek on rotten wood near Castillo Viejo.

3. PERICHÆNA DEPRESSA *Libert*.

Typical. Collected in abundance by Mr. Shimek at Ometépe.

4. CORNUVIA WRIGHTII *Berkeley* and *Cooke*.

Typical. Common at Ometépe. Collected by Mr. Shimek.

5. ARCYRIA CINEREA *Bulliard*.

Typical, though rather large. Common at Castillo. Mr. Shimek.

6. ARCYRIA PUNICEA *Persoon*.

Typical. Castillo and Ometépe.

7. ARCYRIA DIGITATA *Rostafinski*.

Typical. San Carlos, on River San Juan.

8. LYCOGALA EPIDENDRUM *Buxbaum*.

Referred to this species is a single specimen from Castillo. The specimen is very small, only 5 mm. in diameter. The

spores typical, rough and 6μ in diameter. The peridium rough with minute black points. By mistake the spores of this species were on page 127 described as smooth.

9. HEMIARCYRIA RUBIFORMIS *Persoon.*

Rather poor specimens of the type *H. genuina.* From Ometépe and Castillo. Mr. Shimek and Mr. Smith.

10. HEMIARCYRIA CLAVATA *Persoon.*

Spores reticulate. Capillitium smooth as in a single Iowa specimen referred to on page 134 of this volume. Found only on Ometépe. Mr. Smith.

11. HEMIARCYRIA SERPULA *Scopoli.*

Typical and abundant. Remarkable for its uniformly reticulate form. Collected at Ometépe and Castillo.

12. COMATRICHA LONGA *Peck.*

Fine specimens of this species. Sporangium an inch or more long.

13. COMATRICHA SHIMEKIANA *Macbride.* n. s. Plate X, Figs. 3, 3*a* and 3*b*.

Sporangia depressed-spherical or spherical, covered at first as usual with a thin iridescent peridium. Stipe slender, tapering from an indistinct hypothallus, branching immediately on entering the sporangium into several uniform divisions which support the very dense net. Spores smooth pale $7-9\mu$.

"On a log projecting above the water of the Savalos River 12 miles above Castillo el Viejo." Collected by Mr. Shimek.

This is a beautiful species. The spherical sporangia resemble spherical forms of *C. friesiana* R., but are very much larger, two or three times as large; the capillitium of the present species is also to be distinguished by its immediate and symmetrical branching. The branching of *C. friesiana* R., even in spherical forms follows the type of the cylindrical forms and shows something of a central columella.

14. COMATRICHA TYPHINA *Rostafinski.*

Typical specimens from San Carlos. Mr. Shimek.

15. STEMONITIS FUSCA *Roth.*

Typical specimens from Castillo. Collected by Mr. Shimek.

16. STEMONITIS SPLENDENS *Rostafinski.*

Specimens from Ometépe correspond well with specimens of this species received from Europe although I find little if any difference between this and the American form *S. morgani* of Peck.

17. STEMONITIS FERRUGINEA *Ehrenberg.*

Typical specimens from Ometépe. Collected by Mr. Shimek.

18. STEMONITIS SMITHII *Macbride.* n. s. Plate X, Figs. 4, 4*a* and 4*b*.

Sporangium in scattered clusters, springing from a well-developed but not continuous hypothallus, cylindric, short, about 2.5 mm.; stipe about as long as the sporangium proper; peridium evanescent; columella stout, rod-like, extending nearly to the apex; capillitium formed of the rather stout, sparingly divided branches of the columella, which only at the periphery break into twigs to form the very narrow-meshed net; meshes about equal to the spores in diameter; spores pale, smooth 4–5 μ.

This species is allied to *S. ferruginea* R., from which it differs by its minute stature, 5 mm.; from *S. carlylei* Mass., it is distinguished by its much smaller spores. The present species is the most delicate Stemonitis I have yet seen.

19. STEMONITIS CASTILLENSIS *Macbride.* n. s. Plate X, Figs. 5, 5*a* and 5*b*.

Sporangia crowded, stipitate, springing from a well developed hypothallus, about 15–18 mm. including the stipe which is about one-third; columella prominent, extending nearly to

the apex and giving off on all sides, as to the apex, abundant branches to form the capillitium; capillitium open, the meshes coarse and the nodes, especially within strongly dilated throughout; spores globose, brown 7–8 μ, strongly reticulate.

To be compared with *S. maxima* Sz., from which it differs in size, our species being much the larger, but also and especially in the loose coarsely meshed inner net with its strongly dilated nodes.

20. DIDYMIUM BARTERI *Massee*.

I have referred specimens to this species guided by description only, the author of the species having failed to figure it. The correspondence seems sufficiently close except that in our species the spores are only 8 μ in diameter instead of 10–11 μ as recorded. Reference provisional. Collected at Castillo by Mr. C. L. Smith.

21. TILMADOCHE OBLONGA *Rostafinski*.

Typical.

Collected by Mr. Shimek on low grounds at Ometépe.

The plasmodium of this species was collected. The color is bright yellow.

22. PHYSARUM POLYMORPHUM *Rostafinski*.

My specimens correspond well with material identified by the author of the species.

Collected at Ometépe by Mr. Shimek.

23 PHYSARUM NICARAGUENSE *Macbride*. n. s. Plate X, Figs. 2, 2*a* and 2*b*.

Sporangia multilobate or compound contorted, below obconic, grey, ribbed with calcareous thickenings; stem short, fuscous, longitudinally wrinkled; columella none, although the lime massed at the center of each sporangium simulates one. Capillitium white, densely calcareous, with heavy angular nodules connected with comparatively short threads; spores violet, globose, very rough, about 12 μ in diameter.

Seems to be near *P. glaucum* Phillips, but differs at sight in the shape, aggregation and general character of the sporangia.

The species is more calcareous than any Physarum I have seen. The lime sometimes occupies far more space in the sporangium than the spores.

Collected at Ometépe by Mr. Shimek.

24. PHYSARUM MACULATUM *Macbride*. n. s. Plate X, Figs. 1, 1*a* and 1*b*.

Sporangia scattered or gregarious, very small, dull gray, thin-walled, dotted with minute calcareous granules, stipitate; stipe long, stout, attenuated upwards, striate longitudinally or wrinkled, stuffed with irregular yellow masses of lime and accordingly bright yellow in color; columella none; capillitium forming a dense net with comparatively small yellow nodular thickenings; spores globose, purplish, each minutely papillose and displaying several scattered spots occasioned by local development of papillæ; diameter of the spores 9–10μ.

Collected at Castillo by Mr. Shimek.

Near *P. schœteri* R., from which it may by distinguished by shape of sporangium, absence of columella, etc.

25. FULIGO VARIANS *Sommerfelt*.

Typical. Said to be rare.

Collected by Mr. Shimek on Ometépe.

THE MYXOMYCETES OF EASTERN IOWA.

[CONTINUED.]

By THOS. H. McBRIDE.

To the list of species concluded on page 161 of the present volume may be added the following:

1. PHYSARUM OBLATUM *Macbride*. n. s. Plate XI, Figs. 3, 3*a* and 3*b*.

Sporangia gregarious, stipitate, small, bright yellow, depressed globose, rough; stipe reddish brown or fulginous, even, slender, hypothallus none; columella none; threads of the capillitium yellow, delicate connecting the rather dense and abundant yellow lime granules; spores minutely roughened under high magnification, 9–10μ, black in mass, under the lens violet.

A very delicate and beautiful little species collected by Mr. Shimek near Iowa City; to be compared with *P. citrinellum* Pk., from which it differs in its yellow capillitium and larger spores; and with *P. chrysotrichum* B. & C. from which it differs in being stipitate as well as in other particulars.

2. PHYSARUM COLUMBINUM *Macbride*. n. s. Plate XI, Figs. 2, 2*a* and 2*b*.

Sporangia thin-walled, stipitate, gregarious, dove-colored or ashy, delicately flushed, when fresh, with rose, dotted very sparingly with minute white calcareous granules; stipe snow-white, about equal to the diameter of the capsule or a little longer, even; hypothallus none; columella none; threads of the capillitium white, very delicate, with abundant calcareous

nodules which are rather small and rounded; numerous filaments near the sporangium wall contain no lime; spores pale, unequal, dull violet or sooty, minutely papillose, 9–14 μ.

This species is near *P. leucopus* Rost., but is I believe distinct. The marks of difference are seen in the uniformly thin smooth wall of the globular capsule, the delicate capillitium with small lime nodules and the pale, almost smooth spores.

3. CRATERIUM PEDUNCULATUM *Trentepohl.* Plate XI, Fig. 4.

Sporangia gregarious, stipitate, each a wine-glass-shaped cup or urn, dull brown in color, brighter at base and rim, closed by a thin white operculum which is flat or only slightly convex and lies a little below the level of the rim; stipe short, about equal to the cup or less, wrinkled with longitudinal plications which pass upward, appearing slightly on the base of the cup, brown or amber colored, resting upon a small but distinct hypothallus; columella less distinct; capillitium crowded with rather uniform snow-white lime nodules; spores black in mass, pale violet by transmitted light, minutely roughened, 10–12 μ.

Our specimens of this species seem to correspond well with Rostafinski's figures of *C. vulgare*, and it must be admitted that specimens from the same plasmodium sometimes show equally well the characters thought to be distinctive of *C. minutum*. If then *C. vulgare* Ditm., *C. minutum* R., *C. pedunculatum* Trent., *C. pyriforme* Ditm., are all synonyms, it is only a question of priority which specific name shall be adopted. Trentepohl seems to have referred the species to its appropriate genus and Raunkiær has, it seems, properly acknowledged the fact by returning to the old specific name. If Trentepohl's specific name be not adopted, then Rostafinski's should stand and there would seem to be no reasonable excuse for rejecting all the synonymy of the past and introducing at this date a new specific name (once varietal), as *confusum* Massee, and thus increasing the confusion instead of relieving it. The literature is burdened with synonyms as it is, and it certainly

behooves every working systematist to avoid increasing the number, even if by reason of imperfect description justice to earlier students requires the exercise of a little charity.

4. DIDYMIUM SQUAMULOSUM (*Alb. and Schwein.*) *Fries.* Plate XI, Figs. 5, 5*a* and 5*b*.

Sporangia gregarious, stipitate, hemispherical, flattened and umbilicate below, irregularly dehiscent above, about one mm. wide; stipe variable, but entering the sporangium and there forming a distinct spheroidal usually snow-white columella, longitudinally striate, white or pale; capillitium of slender bifurcating filaments radiating from the tips of the columella to the peridial wall; spores minutely papillose, pale violet, 9–12 μ.

This species is rare with us, occurring occasionally on rotting straw heaps, smothering strawberry vines, or decaying herbaceous stems in an over-crowded flower-bed.

Exteriorly with the appearance of a Physarum it is easily distinguished from species of that genus by its entirely different and un-physarum-like capillitium. The stems are usually snow-white when the columella is the same, but sometimes, owing probably to local surroundings, the stipe and columella seem as if stained, pale brown or tawny. The peridium at maturity breaks up into irregular patches white with lime and in this condition presents a uniformly characteristic appearance.

5. DIACHÆA LEUCOPODA *Rostafinski.*

Sporangia cylindric, obtuse, stipitate, iridescent or purple; stipe white, tapering upwards, borne on a white spreading hypothallus; columella cylindric, about two-thirds the height of the peridium white with enclosed lime granules; capillitium of numerous branching and anastomosing threads which are rather thick as they leave the columella but become thinner outwards and support the peridium; spores minutely verruculose, pale violet, about 9 μ.

This species occurs rarely in our forest-lands usually on undisturbed beds of drifted leaves. It is a beautiful thing, one

of our handsomest forms; differs from *D. splendens* Pk., chiefly in the relative proportions of the stipe and columella. The whole sporangium is in the present species cylindric, in the former, globose. For these reasons we have not thought necessary to figure *D. leucopoda.* For character of the genus in general the reader is referred to Plate VII, of the preceding number.

6. TILMADOCHE NUTANS *Rostafinski.*

Sporangia gregarious, depressed, spherical, stipitate, grey or white, thin-walled, nodding; stipe long, tapering upwards, brown or ashen, striate, graceful; capillitium abundant, threads delicate, intricately combined in loose net-work with occasional minute, rounded, calcareous nodules; spores minutely roughened, globose, about 10 μ.

Differs from *T. viridis* Gmel. = *T. mutabilis* R., chiefly in color. Cf. description of *T. viridis* on p. 152. Rare. The only specimens found on a dry bark-less log in the woods near Iowa City.

7. CRIBRARIA DICTYDIOIDES *Cooke and Balfour.*

Sporangia globose, stipitate, gregarious, dull ochraceous, calyculus wanting; peridial ribs broad below tapering upwards, everywhere laterally connected by delicate transverse threads and blending in the net above; net convex with numerous granular nodes, connected in all directions by most exquisite colorless filaments; stipe concolorous; spores small minutely roughened, about 7 μ.

Differs from *C. intricata* Schrader, p. 119, by the absence of a calyculus, and by the fact that the nodes of the net are joined by simple lines, i. e., by simple threads or filaments. The species are sometimes hard to separate.

8. HEMIARCYRIA INTORTA *Lister.*

Sporangia simple, gregarious, short, stipitate, erect, golden yellow, globose-turbinate or pyriform rupturing irregularly at

the top leaving a short funnel-shaped receptacle; sporangium wall thin, translucent, shining; height of the sporangium, including stipe, 1.3 mm.; stipes dark red-brown, longitudinally rugose; capillitium composed usually of single long threads not branched or very sparingly branched; tubes of the capillitium 3.5–4μ in diameter, provided usually with four spirals, sparsely spinulose with short sharp spines, winding evenly and regularly and separated by wide interspaces, two or three times their width, adjoining spirals connected by conspicuous longitudinal filaments. Capillitium and spores concolorous, orange yellow in mass; spores delicately warted 9–10μ.

This is *Hemiarcyria longifila* Rex, whose description I have abridged as above from Proceedings of Academy of Natural Sciences of Philadelphia, 1891, p. 396 (published in 1892). Mr. A. Lister, of England, published in Journal of Botany, September, 1891, a description of the same species, hence the American name becomes a synonym.

The species is with difficulty distinguished from *H. clavata*, but differs under high magnification in the markings of the elater, and in the elater tips. The elaters are plainly hollow and bulbous at the tip but I fail to find in my material the longitudinal filaments "conspicuous."

Not common.

BREFELDIACEÆ.

Sporangia united to form large æthalia which are generally covered with a thin loosely-constructed veil. Single sporangia at maturity without distinguishable peridium hence difficult of individual determination, with or without columella; capillitium arising either from the columella or, in absence of this, from the peridial wall, consisting of stout or well-developed threads, repeatedly branching; without lime; spore mass, deep violet.

BREFELDIA *Rostafinski.*

Sporangia occupying in the æthalium several layers, those of the median, and especially of the lowest layers furnished

with columellæ which blend beneath: capillitium threads in the lowest layers arising from the columella, in the upper extending radiately between the individual sporangia and united at the sporangial limits by means of rather large inflated cells.

9. BREFELDIA MAXIMA (Fr.) *Rostafinski.*

Æthalium large, two to ten inches, papillate above, violet black at first, then purple or purple-brown, developed upon a wide-spread, silver-shining hypothallus; sporangia not distinct, perhaps indicated above by the papillæ; capillitium abundant, the threads uniting by multifid ends to surround as with a net the peculiar vesicles; spore mass dark violet black, the individual spores paler by transmitted light, distinctly papillose, 12–15 μ.

A very remarkable species and one of the largest, rivalled by *Fuligo* only. To be compared with *Reticularia*, which it resembles somewhat externally, and with some of the larger specimens of *Enteridium*. The plasmodium at first white with a bluish tinge is developed abundantly in rotten wood, preferably a large oak stump, and changes color as maturity comes on, much in the fashion of *Stemonitis splendens*, leaving a wide-spread hypothallic film to extend far around the perfected fruit-mass. The capillitium is very peculiar. Large irregularly formed columellæ in the lower strata of the æthalium rise as ascending branches of an intricate but rather clumsy frame work which lies close upon the hypothallus. From these columellæ, as far as they go, the capillitial filaments radiate. Only above, as it appears, do the filaments join their distal, peripheral ends by network enclosing vesicles. The spores are very large, distinctly, rather coarsely spinulose, nucleated. By both capillitium and spores one is reminded constantly of some large *Stemonitis*. It is a Stemonitis whose sporangia have never been perfectly differentiated.

A figure of the species will appear in some subsequent plate.

Muscatine County, Iowa. Reported hitherto from Great Britain and Germany.

Iowa City, Iowa, September, 1893.

A NEW PHYSARUM FROM COLORADO.

By THOS. H. McBRIDE.

PHYSARUM NEWTONI *Macbride*. n. s. Plate XI, Figs. 1, *1a* and *1b*.

Sporangia simple, gregarious, short stipitate or sessile, globose or flattened, when not globose depressed and deeply umbilicate above, purple, smooth, thin-walled, stipe when present very short and concolorous; columella none; hypothallus none; capillitium abundant, delicate, with more or less well developed nodules, which are also concolorous; spores by transmitted light, dark brown, thick-walled, rough, nucleated, about 10 μ.

A very handsome little species collected by Prof. G. W. Newton in Colorado at an altitude of several thousand feet. Easily recognized by its almost sessile, rose-purple generally umbilicate sporangium.

Iowa City, Iowa, September, 1893.

A NEW CYCAD.[1]

By THOS. H. McBRIDE.

In 1868, Mr. W. Carruthers described under the generic name *Bennettites* certain fossil cycadaceous plants from the Lower Green Sand of the Isle of Wight.[2] The most striking and apparent feature of the genus Bennettites would seem to be its elliptical outline and the circumstance that the flower buds arise irregularly from the inner bark and from among or between the leaf bases. Certain fossils obtained by the writer, near Minnekahta in South Dakota seem not only to belong to this genus but to illustrate its character unusually well. The specimens described, were found (in company with forty or fifty more) weathered out on a hill-top. The rocks below and above are sand, and if I may judge by such knowledge as I have at present, the fossils under discussion are from the Jura-Trias or lower Cretaceous.

BENNETTITES DACOTENSIS *Macbride*. n. s. Plate XII.

Plant for the most part silicified, plainly elliptical in section, the measurements for the specimen before me are: girth three feet six inches, height thirteen inches, longer diameter fourteen inches, shorter eleven and one-half. The pith large, simply cellular, punctate where weathered, destitute of fibro-vascular bundles, surrounded by a woody cylinder which is from an inch to one inch and a quarter in thickness. The wood is divided at regular intervals by numerous medullary rays

[1] Reprinted in part from the *American Geologist* for October, 1893.

[2] See Trans. Linnæan Society, Vol. 26, p. 675, seq. London, 1868.

about one-half inch in width. A thin rind or bark surrounds the woody cylinder and supports the bases of the leaves and leaf structures. Leaves are not known: their bases as preserved are fusiform or lozenge-shaped in cross-section, half an inch by one inch in dimensions, and show the remains of numerous equally developed fibro-vascular bundles. Between the leaf bases are numerous intervals filled up with structures (perhaps paleæ) imperfectly preserved. Where the surface of the fossil is best preserved, the leaf bases appear to have rotted away to a considerable distance inwardly, and the entire surface is pitted, and presents a clathrate or reticulate appearance. Rising through the outer conglomeration of tissues, leaf-bases and adhering structures, appear numerous buds (flower-buds?); these are about two inches in diameter and of equal height, attached to the rind by a short cylindrical stem, and made up, outwardly, at least, of rather slender, scale-like leaves arranged in circular whorls.

In habit the plants were solitary or in groups or clusters of two or three apparently from the same base, and sometimes reached much greater dimensions than those recorded—being sometimes at least two feet high.

The present species is near *Bennettites gibsonianus* Carr., from which it may be distinguished by greater size and by the fact that in our species the fibro-vascular bundles of the leaf-stems are of uniform size and distribution, and do not form a horse-shoe shape in cross-section as is said to be the case in the English species.

In Vol. XV, Monographs of the United States Geological Survey, 1889, Mr. W. M. Fontaine records and describes certain Cycad fossils from the Potomac Beds in Maryland. These fossils are referred to a proposed genus *Tysonia* thought to be intermediate between *Bennettites* Carr., and *Mantellia* Brongn. I have no doubt but that our Dakota specimens belong to the genus *Bennettites*, whatever may be the case in reference to the Maryland fossils, although I may be permitted to suggest that these latter also belong to the

same genus, as Mr. Carruthers has already concluded. As far as species is concerned, the Dakota form differs at sight in the relatively small number of leaf-scars and their very much greater size, as well as in the fact that the flower-buds(?) are few, large, pedicellate, and almost entirely exterior to the leaf-base armament. As, for the Maryland species, no microscopical characters are given, no comparison relative to the fibro-vascular bundles can now be made. Furthermore there is in the Dakota species no indication of a lateral terminal bud. As to the geologic age to which the Dakota fossils belong, the great similarity between the eastern and western specimens would seem to indicate practical identity of horizon so that *B. dacotensis* indicates for us the equivalent in Dakota of the Potomac formation, whatever that may be.[1]

In external form, the perfect specimens of this fossil remind one very suggestively of the pitted stems of a modern *Macrozamia spiralis* Miquel, from Australia. The most conspicuous external difference lies in the peculiar character and position of the fruit- or flower-buds in the fossil species. It is to be regretted that in this part of the world material is not just now at hand for more exact comparison. Australia is a Mezozoic land and a close resemblance between our fossils and existing Australian species would not be surprising.

Special thanks are due Hon. Thos. Wright, of the C., R. I. & P. railway, and Mr. J. Francis, Gen. T. & P. Agt. of the B. & M. railway in Nebraska, for special assistance in the conduct of these investigations.

Iowa City, Iowa, September, 1893.

[1] More recent investigations of the question of geological horizon lead to the undoubted conclusion that the fossils are Cretaceous and come from the sandstone beds called by Meek and Hayden the Dakota group.—*Nov. 16th, 1893.*

SOME CENTRAL AMERICAN PYRENOMYCETES.

By CHARLES L. SMITH.

The Pyrenomycetes are readily distinguished, for the most part, from other cryptogamous plants. The name signifies "fire fungi" and many species do give the appearance of being charred to parts of branches, bark and pieces of decaying wood. This distinguishing character will not do for all, for many are small and scattered so that no such appearance is produced on the substratum, yet one soon learns to distinguish such forms to be Pyrenomycetes. As the name might indicate, they are generally black, or nearly so. But we must notice two groups which are noted either for being usually of a bright color or for developing generally an abundance of mycelium.

The Hypocreaceæ are distinguished by being of some other color than black, often of some bright color as red, blue, etc., and by being fleshy or leathery-membranaceous with a waxy or, at least, soft stroma, when one is present. The Hypocreaceæ are never carbonaceous whereas the rest of the Pyrenomycetes generally are quite perceptibly so. The blights (Erysipheæ) produce commonly a conspicuous white mycelium sprinkled over with small black or dark brownish bodies (the perithecia) and are commonly found parasitic on the leaves of many species of phenogamous plants.

Saccardo defines the Pyrenomycetes as,—Fungi furnished with asci-bearing perithecia, generally growing on plants, seldom on animals and never truly terrestrial. They have many secondary or metagenetic phases composing families of the Sphæropsideæ, Melanconieæ and Hyphomycetes.[1]

[1] Sacc. Syll. I, p. 1.

The perithecia are small cases, so to speak, exhibiting usually a spherical or flask-shaped form, and are lined with hymenium in the lower part and are generally pierced at the apex, the opening being called an ostiolum. The perithecia are often prolonged around the ostiolum into a neck, or beak, the better probably to disperse the sporidia. The perithecia may be superficial or sunk more or less into the matrix or more or less sunk in a body like the perithecia in substance and varying in size and shape, known as the stroma. The stroma may consist of a transformed part of the matrix. The hymenium consists of two kinds of elongate cells. One is saclike, the asci, in which are produced the sporidia. The sporidia are reproductive bodies, generally eight in number, and in many cases they have proven to be the product of fertilization. The cells of the other kind are rather slender and often are much like the asci, among which they are situated. They are thought by some to be abortive asci and are called paraphyses.

The secondary or metagenetic phases often cover the forming stroma, forming on the aërial branches of the mycelium conidia (gonidia) or in the forming perithecia or similar conceptacles, at the apex of hyphæ, so-called pycnidia. It is commonly conceded (although in but few cases proven) that their growths are a part of the plant on which they appear, although in some cases a parasite form of some other fungus appears on the growing Pyrenomycete. The conidia, gonidia and pycnidia are asexual reproductive bodies.

The Pyrenomycetes given in this paper were collected in Nicaragua by the expedition sent out last December by the State University of Iowa. (See Mr. B. Shimek's article in this Bulletin.)

The name of the locality is given with each species followed by the initials of the person or persons collecting it. If the species was collected in two localities, the names of the two places are given.

A large majority of the species were collected during the

stay at Castillo Viejo, within a radius of a few miles of the little village. When it is known that the species enumerated in this article, constitute less than one fifth of the species collected at this one place, some idea of the richness of the mycological flora of a tropical region may be formed.

It is to be noted that about two-fifths of the species collected are new species and that two genera and thirteen species are not given in North American Pyrenomycetes.

The species and genera mentioned in this paper and not described in North American Pyrenomycetes, are here described. The descriptions are translations from Prof. P. A. Saccardo's Sylloge in all cases, for I discovered, in the few in which I had the opportunity to compare the original descriptions with those of the Sylloge, that those of the Sylloge are fuller. This is done for the benefit of those who may not have a more comprehensive treatise upon this very interesting group of plants than Mr. J. B. Ellis' valuable work, North American Pyrenomycetes.

All the species have been identified and the new species described by Mr. J. B. Ellis, who has also re-written the descriptions of *Xylaria guyaniensis*, *X. obovata*, *X. pumila* and *Glaziella vesiculosa*. Nothing could be made of a few specimens, because they were old or immature.

I have followed the classification given by Mr. Ellis in North American Pyrenomycetes.

ORDER PYRENOMYCETES.

I. PERISPORIACEÆ.

FAMILY ERYSIPHEÆ.

No species collected.

FAMILY PERISPORIEÆ.

MELIOLA HORRIDA *E. & E.* n. sp.

Hypophyllous. Mycelium black, forming orbicular patches 2–4 mm. dia., and consisting of much branched and anasto-

mosing-prostrate hyphæ, with small, 2-celled, capitate hyphopodia about $12 \times 7–8\mu$, the upper cell rounded, often oblique, and an abundance of black, straight, simple bristles about $200–270\mu$ long, $6–7\mu$ thick, sparingly and obscurely 3–5-septate, arising from the prostrate threads. Perithecia ovate, small, about 100μ dia., bald or with a few short bristles similar to those from the mycelium. Asci obovate, sub-sessile, about $60–70 \times 15–20\mu$, 2-spored. Sporidia oblong-cylindrical, 4-septate, scarcely or finally slightly constricted, brown, narrowed towards each end, $25–34 \times 11–14\mu$.

Differs from *M. microspora* Pat. & Gail., in its anastomosingly branched mycelium which lacks the mucronate hyphopodia, in its more slender and more abundant bristles, and in its sporidia more attenuated at the ends. *M. polytricha* Kalch. & Cke., has longer, flexuous bristles and longer sporidia not attenuated at the ends and has both capitate and mucronate hyphopodia.

Parasitic on the leaves of guava, Jan., '93, San Carlos. (C. L. S.)

II. HYPOCREACEÆ.

HYPOCREA BICOLOR *E. & E.*, J. Myc. IV, p. 58.

On decaying wood, Ometépe. (B. S.)

H. FIBULA *De Not.*

Stroma cervine becoming fuscous, convex-disk-form, centrally adnate below, with obtuse margin, fleshy within. Perithecia quite numerous, small, globose, discrete, separating from the stroma, a little prominent at the apex, dehiscing by a minute, rotund pore. Asci, cylindrical, very plentiful. Sporidia didymous, globose joints, equal.

On trunks of trees in South America. [Sacc. Syll. II, p. 527.]

A few immature specimens on a fallen tree, Castillo Viejo. (C. L. S.)

H. HIRSUTA *E. & E.* n. sp.

Stromata gregarious or crowded, sub-hemispherical, coriaceo-

carnose, 2–3 mm. across, discoid, obsoletely margined, brown, yellowish-white inside, contracted below, centrally attached, clothed with brown, bristle-like, septate hairs, 100–200×4 µ, convex or plane above and slightly roughened by the papilliform ostiola. Perithecia buried in the stroma, sub-distichous, ovate, about ½ mm. high. Asci, clavate-cylindrical, swollen at the tip, 100×10 µ (or about that). Sporidia navicular-oblong, or inequilaterally elliptical, brown, 7–8×3–3½ µ.

On bark, Ometépe and Castillo Viejo. (C. L. S.)

NECTRIA EPISPHÆRIA (*Tode*) *Fr.*

On *Xylaria corniformis* Fr., Castillo Viejo. (C. L. S.)

N. SANGUINEA (*Sibth.*) *Fr.*

On bark of decaying tree with *Poronia turbinata* E. & E., Castillo Viejo. (C. L. S.)

N. STRIISPORA *E. & E.* n. sp.

Cespitose. Perithecia narrowed-ovate, about 1×½ mm., clothed with a yellow, granulose-furfuraceous coat, crowded in tufts, 2–3 mm. across, 20–100 together. Ostiolum obtuse, broad-papilliform, amber-colored, soon perforated. Asci clavate, p. sp. 80–100×12–15 µ, with evanescent paraphyses, 8-spored. Sporidia irregularly crowded, large, broad-oblong-fusoid, 30–38×8–10 µ, yellowish-brown, uniseptate and slightly constricted, each cell 3–5-nucleate, finally assuming a striate appearance, from being filled, apparently with linear-cylindrical bodies.

This seems to be a well marked species; on account of the nuclei, sometimes apparently 3–5-septate, but there is only one true septum.

On bark, Castillo Viejo. (C. L. S.)

N. OBSCURATA *E. & E.* n. sp.

Perithecia scattered or 2–3 together, ovate, 250–300 µ dia., dull dirty red, smooth. Ostiolum papilliform, soon perforated.

Sporidia oblong-elliptical, hyaline, uniseptate, not constricted, $7-8 \times 3 \mu$. The asci in the specimens examined had disappeared.

Possibly this might be considered a variety of *N. sanguinea* but the perithecia are rather larger and lack the bright red color of that species and the sporidia are smaller.

On bark, Castillo Viejo. (C. L. S.)

GLAZIELLA *Berk.*[1]

A genus embracing certain species which have been referred to *Xylaria* and *Hypoxylon*.

Stroma sub-globose, carnose, brightly colored. Perithecia pallid, for a long time filled with a hyaline jelly (at length in *G. abnormis* ascophorous; asci cylindrical; sporidia very minute, monostichous). A genus with a manifestly hyprocreaceous mode of life, but doubtful because the fructification is unknown in many of the species. [Sacc. Syll., II, p. 581.]

G. VESICULOSA *Berk.* (*pro tem.*)

Stroma obovate, about 3½ cm. high and broad, short stipitate, hollow and inflated, consisting of a mere shell, 1½–2 mm. thick, orange yellow, entirely closed without any apical or other opening. Perithecia immersed, numerous, immature, without any distinctly formed asci or sporidia.

On a dead tree, Ometépe. (C. L. S.)

III. SPHÆRIACEÆ.

FAMILY CHÆTOMIEÆ.

No species collected.

FAMILY SORDARIEÆ.

No species collected.

FAMILY TRICOSPHÆRIEÆ.

TRICOSPHÆRIA HORRIDA *E. & E.* n. sp.

Perithecia gregarious and cespitose, superficial, membranaceous, globose, ¾ mm. dia., collapsing above, clothed with

[1] F. Brazil in Meddel. Naturh, Kjobenhavn, 1879–80, p. 751.

coarse, brown hair and abundant stout, straight spines, 100-250×8 μ. Asci clavate, short stipitate, 45–50×7–8 μ, obscurely paraphysate, 8-spored. Sporidia bi-seriate, acutely elliptical, hyaline, 2-nucleate, 6–8×2½ μ.

Tr. pulchriseta (Pk.)[1] has about the same sporidia but the perithecia are more scattered and much smaller. *Tr. pilosa* (Pers.) has also much smaller perithecia and the sporidia (see Winter's fig.) are different.

On bark, Ometépe. (B. S.)

HERPOTRICHIA DIFFUSA (*Schw.*) *E. & E.*

On decaying bark, Castillo Viejo. (C. L. S.)

H. NICARAGUENSIS *E. & E.* n. sp.

Perithecia superficial, densely gregarious, ovate, ½–¾×⅓–½ mm., rough, pruinose-pilose at first, soon bald. Ostiolum broad-papilliform, soon broadly perforated. The asci, in the specimens seen, had disappeared. Sporidia oblong-elliptical, uniseptate, not constricted, hyaline at first, then olive-brown, 8–10×5 μ.

On rotten wood, Ometépe. (B. S.)

FAMILY MELANOMMEÆ.

ROSELLINIA PROTUBERANS *Karst.*

Perithecia more or less scattered, sub-innate, finally more or less emergent, the free part hemispherical and concrete with the dark-fuscous-tinctured wood, spheroidal, dark-fuscous, fragile, 0.5–0.7 mm. wide, furnished with a papillate, minute, slightly prominent ostiolum. Asci cylindrical, 78×6–8 μ (p. sp.), stipe 30–40 μ long. Sporidia 8, monostichous, ellipsoidal, soon inequilateral, 2-guttulate, fuscous, 10–12×5–6 μ. Paraphyses numerous, coalescing.

On willow wood, Fennia and on the wood of *Cornus sanguinea* in northern Italy. [Sacc. Syll., I, p. 262.]

[1] This is Mr. Ellis' use of the parentheses.

On decaying wood, Castillo Viejo. (C. L. S.) In one case, the substratum of the wood was very darkly colored and in another scarcely colored at all.

R. GIGASPORA *E. & E.* n. sp.

Gregarious, superficial, conic-hemispherical, 1–1½ mm. dia., sessile, with a broad, flattened base, surrounded apparently at first by a thin, brown, hairy subiculum spreading over the surface of the wood and clothing the lower part of the perithecia. Ostiolum globose-papilliform, black and smooth. Sporidia broad-fusoid, brown, $55–62 \times 10–12\,\mu$. The specimens were past their prime and the asci had disappeared.

On dead cane (?) stalk, Castillo Viejo. (C. L. S.)

R. GIGANTEA *E. & E.* n. sp.

Perithecia gregarious, globose, sessile, 2½–3½ mm. dia., covered with a granulose-pruinose coat at first, except the black, conical ostiolum, at length bare and reddish-brown, often marked around the base of the ostiolum with short, subradiate furrows; wall double, outer carbonaceous, firm, ⅓ mm. thick, inner membranaceous. The perithecia are surrounded by a growth of dark-brown, bristle-like fascicles of closely compacted, reddish-brown, rather distantly septate hyphæ about 2 mm. high, arising from a sub-crustose subiculum; oblong-elliptical, hyaline, $5–6 \times 2–3\,\mu$ conidia were associated with the bristle-like fascicles of hyphæ, but the mode of attachment was not seen. Asci cylindrical, p. sp. $250–270 \times 8\,\mu$, paraphysate, 8-spored. Sporidia overlapping uniseriate, fusoid, slightly curved, acute, with two large oil globules, olivaceous at first, then opake, $40–62 \times 6–8\,\mu$.

R. desmazierii (B. & Br.) has smaller perithecia and sporidia, and *R. bunodes* (B. & Br.) has the perithecia rather smaller, the sporidia more attenuated at the ends, and conidia moniliform.

On bark, Castillo Viejo. (C. L. S.)

R. MELALEUCA *E. & E.* n. sp.

Perithecia gregarious, or crowded, sub-obovate, ½–¾ mm. dia., obtusely rounded and white pruinose above, except the minute, papilliform, black ostiolum, black below and connected by a thin, black crust. Asci (p. sp.) cylindrical, about $50 \times 5 \mu$, paraphysate, 8-spored. Sporidia uniseriate, inequilaterally elliptical, brown, finally opake, continuous, $8–10 \times 4 \mu$.

On wood, Ometépe. (C. L. S.)

R. ———— ?

Old specimens without fruit. This might be a *Lasiosphæria*. On bark, Castillo Viejo. (C. L. S.)

MELANOPSAMMA SHIMEKII *E. & E.* n. sp.

Perithecia gregarious, superficial, ovate-conic, about ¾ mm. dia., brownish-black, and, except the smooth, black, conic-papilliform ostiolum, muricately roughened and clothed with scattered, short, pale, glandular hairs. Asci clavate-cylindrical, short stipitate, $150–180 \times 12–15 \mu$, 8-spored, overtopped by the abundant, filiform paraphyses. Sporidia crowded-biseriate, fusoid, uniseptate and constricted, slightly curved, $48–57 \times 10–12 \mu$, yellowish-hyaline, ends at first acute, then sub-obtuse.

M. papilla (Schw.) and *M. obtusissima* (B. & C.) come nearest this but both have smooth perithecia.

On dry, hard wood, Ometépe. (B. S.)

MELANOMNA SUBCONICUM *E. & E.* n. sp.

Perithecia depressed-conic-hemispherical, erumpent-superficial, covered by the blackened epidermis, scattered, about 1 mm. dia., sub-angular; ostiolum papilliform. Asci cylindrical, $100 \times 10 \mu$ (p. sp. $60–70 \mu$ long), with abundant, filiform paraphyses, 8-spored. Sporidia uniseriate, oblong-elliptical, obtusely pointed and with a small hyaline protuberance at each end, obscurely 3–4-pseudo-septate, $12–15 \times 6–7 \mu$, olive-brown.

On bark, Castillo Viejo. (C. L. S.)

FAMILY CERATOSTOMEÆ.

CERATOSPHÆRIA CASTILLENSIS *C. L. Smith.* n. sp.

Perithecia crowded-gregarious, superficial, ovate, about ½ mm. dia., clothed with a thin, brown, pilose-tomentose coat; ostiolum cylindrical, stout, rough, black, ½–¾ mm. long. Asci oblong-cylindrical, short stipitate, $75–85 \times 8–10\,\mu$, 8-spored. Parapyhses(?) Sporidia fasciculate, fusoid, slightly curved, hyaline, 3-septate, $25–28 \times 3\frac{1}{2}\,\mu$.

Differs from *C. fuscella* Karst., in its tomentose perithecia and curved, fasciculate sporidia.

On bark, Castillo Viejo. (C. L. S.)

FAMILY AMPHISPHÆRIEÆ.

No species collected.

FAMILY LOPHIOSTOMEÆ.

LOPHIOSTOMA OVINUM *E. & E.* n. sp.

Gregarious, superficial, sub-globose, clothed, except the convex-prominent, elliptical, longitudinally cleft ostiolum, with a dense, white, tomentose-squamose, closely adherent coat, so as to resemble *Lasiosphæria ovina* (Pers.) Asci clavate, short stipitate, about $60 \times 10\,\mu$, with abundant filiform paraphyses. Sporidia biseriate above, narrowed-oblong-elliptical, or sub-conical, uniseptate and constricted, $15–20 \times 4–5\,\mu$, at first hyaline and nucleate, becoming at length pale brown.

On a decaying part of a live tree, Castillo Viejo. (C. L. S.)

FAMILY CUCURBITARIEÆ.

No species collected.

FAMILY SPHÆRELLOIDEÆ.

No species collected.

FAMILY GNOMONIEÆ.

No species collected.

FAMILY PLEOSPOREÆ.

No species collected.

FAMILY MASSARIEÆ.

No species collected.

FAMILY CLYPEOSPHÆRIEÆ.

No species collected.

FAMILY VALSEÆ.

DIAPORTHE CRINIGERA *E. & E.* ?

A specimen having the outward appearance of *Diaporthe crinigera*, E. & E. Ometépe (B. S. & C. L. S.)

EUTYPELLA STELLULATA (*Fr.*) *Sacc.*

In the bark of a dead branch, Ometépe. (C. L. S.)

FAMILY MELANCONIDEÆ.

PSEUDOVALSA SMITHII *E. & E.* n. sp.

Perithecia 4–8 together, ovate, about 1/3 mm. dia., connate so as to form a sub-hemispherical tubercle 1–1 1/2 mm. dia., and crowned in the center with the tuft of short ostiola which is finally deciduous, leaving the stroma perforated. These stromata are gregarious or sub-confluent and appear to have been at first covered by the epidermis, but, in the specimens examined, this had entirely disappeared, leaving the stromata superficial. Asci not seen. Sporidia fusoid, slightly curved, deep brown, almost opake, $52–62 \times 10–14 \mu$, 3-septate, the two end cells small and paler. No appendages were visible but these may have disappeared.

Ps. bicornis (Cke.) differs in its separate (not connate) perithecia. The sporidia are much like those of *Ps. sigmoidea* (C. & E.), but the habit is different.

On bark of dead tree, Castillo Viejo. (C. L. S.)

FAMILY MELOGRAMMEÆ.

No species collected.

FAMILY DIATRYPEÆ.

DIATRYPELLA PAUPERA *E. & E.* n. sp.

Stromata tuberculiform, small, 1–1 1/2 mm. dia., black out-

side, dirty greenish-yellow within, closely embraced around the base by the appressed margin of the ruptured epidermis. Perithecia only 2–4 in a stroma, globose, about ⅓ mm. dia., ostiola papilliform, slightly prominent. Asci clavate, p. sp. $55–60 \times 10–11\,\mu$, stipe $45–50\,\mu$ long, slender. Sporidia numerous, allantoid, hyaline, moderately curved, 2-nucleate, varying in length from $5–9\,\mu$ and $1\frac{1}{2}–2\,\mu$ wide.

The stromata are of about the size and shape of those of *Diatrype prominens* Howe.

On dead limbs, Castillo Viejo. (C. L. S.)

IV. DOTHIDEACEÆ.

MYRIANGIUM DURIEUI *Mont. & Berk.*

On bark, Castillo Viejo. (C. L. S.)

FAMILY XYLARIEÆ.

NUMMULARIA REPANDA (*Fr.*) *Nits.* var. *Zonata* E. & E. n. var.

This is probably a new species differing from *N. repanda* in its elongate, cylindrical perithecia and more prominent, rugose-zonate stroma. But it is immature and entirely without asci or sporidia.

On bark of a tree, Castillo Viejo. (C. L. S.)

N. HYPOPHLŒA (*B. & Rav.*) *Cke.* ?

On bark of a tree, Castillo Viejo. (C. L. S.)

N. RUMPENS *Cke.* ?

The specimens were old and no sporidia were found.

On bark, Castillo Viejo. (C. L. S.)

N. TINCTOR (*Berk.*) *Cke.*

The specimens collected at Ometépe had not tinged the adjacent bark and wood orange red. The specimens from Castillo Viejo were typical in this respect. (C. L. S.)

N. VERNICOSA *E. & E.* n. sp.

Stroma effused, thin, rather less than 1 mm. thick, oblong or elliptical, 2 cm. or more long, margin broadly sterile, smooth and shining black. Perithecia monostichous, short-ovate, ⅓–½ mm. dia., entirely immersed, and occupying the central part of the stroma; ostiola papilliform, surrounded by an annular depression as in *Hypoxylon annulatum.*

The surface of the stroma over the part occupied by the perithecia is without luster.

In the specimens examined the asci and sporidia had entirely disappeared but the species seems so well marked othwise, that we have ventured to give it a name.

On thin bark of a small dead limb, Castillo Viejo. (C. L. S.)

N. RUFA *E. & E.* n. sp.

Effused, thin, 1 mm. or less in thickness, somewhat irregular in outline, ½–2 cm. across, or interruptedly sub-confluent, reddish-brown, at first very thin and entirely sterile with an even surface, then somewhat roughened in the center by the slightly projecting apices of the perithecia with their minute, black, conic-papilliform ostiola. Perithecia about ⅓ mm. dia., sub-globose. Asci cylindrical, $60–70 \times 3\,\mu$, 8-spored. Sporidia uniseriate, navicular-oblong, pale brown, $3\frac{1}{2}–4\frac{1}{2} \times 2–2\frac{1}{2}\,\mu$.

Differs from *N. hypophlœa* (B. & R.), in its color, its slightly prominent perithecia and smaller, paler sporidia; and the subjacent wood and bark are blackened but not stained yellow or olive as in that species.

On bark, Ometépe. (C. L. S.)

HYPOXYLON COCCINEUM *Bull.*

On bark, Ometépe. (B. S. & C. L. S.)

H. ANNULATUM (*Schw.*) *Mont.*

On bark, Ometépe. (B. S.) Also the variety *depressa* Fr., was collected at Castillo Viejo. (C. L. S.)

H. POLYSPERMUM *Mont.*

Collected several times on bark of dead limbs and trees, Ometépe. (B. S. & C. L. S.) Castillo Viejo. (C. L. S.)

H. CALLOSTROMA (*Schw.*) *Berk.*

On the fire-wood of a steamboat, near Castillo Viejo. (B. S.)

H. FOSSULATUM *Mont.* ?

Erumpent, long and widely effused. Stroma carbonaceous, applanate, sub-undulate, black-fuscous, pitted. Perithecia oblong-ovoid, concolorous, with a little prominently punctiform and central ostiolum in each pit which is at first white-pruinose, finally nude.

On the bark of trees, Cayenne (Leprieur). [Sacc. Syll. I, p. 380.]

The specimens agree with the description of *H. fossulatum* Mont., and tolerably with specimens of that species from the Orinoco river, only the perithecia are more scattered.—(Ellis.)

On bark of rotten stick, Castillo Viejo. (C. L. S.)

H. CYLINDROPHORUM *E. & E.* n. sp.

Stroma pulvinate, elliptical, 2×1 cm. or by confluence larger and more irregular, consisting of a thin (1 mm.), carbonaceous, rusty black, superficial layer covering the cylindrical, flesh-colored, 3–4 mm. long, carbonaceo-membranaceous perithecia, and slightly roughened by the conic-papilliform, sub-umbilicate ostiola. The perithecia extends down to the wood. Asci cylindrical, p. sp. $22\text{–}25 \times 3\,\mu$, or including the slender stipe $35\text{–}40\,\mu$ long, paraphysate, 8-spored. Sporidia uniseriate, often oblique, oblong-elliptical, pale brown, $3\text{–}3\frac{1}{2} \times 2\,\mu$.

When the stroma is broken in two, the elongated perithecia remind one of the peridia of *Tubulina*.

On dry, hard wood, Ometépe. (C. L. S.)

H. NICARAGUENSE *E. & E.* n. sp.

Stroma discoid, 2–3 cm. dia., convex, reddish-purple, becom-

ing black outside, of light and corky substance, umber colored within; margin reflexed, sub-lobate or undulate. Perithecia monostichous, peripherical, narrowed-ovate, 1 mm. high, ½–¾ mm. broad, crowded; ostiola papilliform. Asci cylindrical, p. sp. about $60 \times 7\,\mu$, with filiform paraphyses, 8-spored. Sporidia navicular-oblong, pale brown, uniseriate, $8–12 \times 3\frac{1}{2}–5\,\mu$.

Allied to *H. petersii* B. & C., from which it differs in the reflexed margin of the stroma and the monostichous perithecia.

Ometépe (B. S. & C. L. S.); and on firewood of a steamer, near Castillo Viejo (B. S.)

H. PERFORATUM (*Schw.*) *Fr.* ?

A few specimens having the appearance of *H. perforatum* (Schw.) but the few sporidia only $6–7 \times 3\,\mu$ (Ellis).

On bark of decaying branch, Ometépe. (B. S.)

H. RUBIGINOSUM (*Pers.*) *Fr.*

Many specimens of this species were collected. One specimen of this species apparently, on a rotten "bamboo cane," is a very thin form. On wood, Ometépe (B. S. & C. L. S.); and Castillo Viejo (C. L. S.)

H. PAPILLATUM *E. & E.* n. sp.
(H. TERES *B. & C.*, in Herb. Berk. sec. Cke.)

Stroma pulvinate, irregular in shape, 4–6 cm. long, 2–4 cm. wide, 3–4 mm. thick, clothed at first with an olive-yellow conidial layer which becomes reddish-ferruginous and finally disappears, leaving the stroma black. Perithecia monostichous, peripherical, oblong or cylindrical, 1–1½ mm. long, their apices prominent, slightly flattened, with a papilliform ostiolum, finally perforated. Asci cylindrical, 70–90 μ long (p. sp.), with a slender stipe 30–35 μ long, paraphysate, 8-spored. Sporidia narrowed-elliptical, nucleate, olivaceous, becoming opake, $10–12 \times 4\frac{1}{2}–6\,\mu$. Conidia globose, minute.

This is certainly different from *H. teres* Schw.

On decaying wood of various deciduous trees, Kansas (Cragin), Canada (Dearness), Ohio (Morgan), Delaware (Commons), Louisiana (Langlois), Nicaragua (C. L. Smith). Mr. Ellis had received specimens of this species from different localities before he received my Nicaraguan specimen.

H. INSIDENS (*Schw.*) *E. & E.* ?

A few old specimens were collected which were thought to be very close to this species. On wood, Ometépe. (B. S.)

H. ———— sp. ?

A number of specimens which were too old to show their true color and the asci were gone. The sporidia were too large ($27 \times 10 \mu$) for *H. argillaceum* Pers., which it might otherwise have been.—(Ellis.)

On rotten wood, Castillo Viejo. (C. L. S.)

KRETZSCHMARIA *Fr.*

Densely cespitose, effused; capitula short, black, carbonaceous, sometimes a little divided and stipitate, sometimes on short, much divided branches. Asci cylindrical, generally 8-spored. Sporidia ovate-fusoid, continuous, sooty.—A genus between *Xylaria* and *Hypoxylon.*—[Sacc. Syll. II, Add. p. xxix.]

KR. CŒNOPUS (*Mont.*) *Sacc.* (*Vide* Sacc. Syll., II, Add. p. xxix.)

Black. Tubercles plane, sub-stipitate, narrowed below, crowded on an undulate crust. Perithecia sub-immersed, with a punctiform ostiolum. Asci...... Sporidia 10μ long. —(Berk.)

On decaying wood and bark, Cuba, Surinam, Ceylon, Brazil and Borneo. Perithecia large, ovoid, few in a tubercle. There is an apodous variety and a large variety in Brazil. [Sacc. Syll. I, p. 388.]

On bark of decaying trunk, Ometépe and Castillo Viejo. (C. L. S.)

KR. PUSILLA *E. & E.* n. sp.

Stroma clavate, stipitate. Head depressed-spherical, brownish-black, mostly not over 2 mm. dia.; stipe slender, 3–4 mm. long and about 1 mm. thick, branching from near the base two to four together. Perithecia entirely buried, sub-globose, about ¾ mm. dia., 8–12 in a stroma; ostiola minutely papilliform. The asci in the specimens examined had disappeared. Sporidia navicular-fusoid, opake, $20–22 \times 6 \mu$.

Differs from *K. clavus* Fr., in its diminutive size and more numerous perithecia.

On fallen tree trunks, Castillo Viejo. (C. L. S.)

PORONIA HELISCUS *Mont.*

Cespitose, small, wedge-shaped, corky, more or less scaly or scabrous, black, white within, with a placentiform disk. Perithecia globose, immersed, colliculose; ostiolum a little prominent, umbonate. Sporidia apparently 1-seried, navicular-pyriform, $7\frac{1}{2}–10 \mu$ long, black-fuliginous.

On trunks of dead trees, Cayenne (Leprieur). Montagne describes the sporidia as bilocular, but Currey figures them, from the original specimens, as continuous. [Sacc. Syll. I, p. 349.]

On bark of tree trunks, Ometépe and Castillo Viejo. (C.L.S)

P. TURBINATA *E. & E.* n. sp.

Stromata gregarious, or sub-cespitose, carnose-coriaceous, top-shaped, about 3 mm. broad and high, black outside, white within, convex above and slightly roughened by the papilliform ostiola, immarginate, sub-discoid, abruptly contracted below into a short, sub-compressed stipe. Perithecia peripherical, monostichous, globose, ½–¾ mm. dia., buried in the stroma, with the apex scarcely prominent, about 20 or 25 in a stroma. Asci clavate-cylindrical, $75 \times 6–7 \mu$, swollen at the apex, paraphyses none, 8-spored. Sporidia uniseriate, navicular-oblong, 2-nucleate, hyaline at first, then olivaceous and finally opake, $12–14 \times 5–6 \mu$.

The stroma is sub-plicate below and easily breaks away from the bark. *Sphæria intermedia*, Schw., Syn. N. A. 1166,

is described as "pulvinate-cupulate," i. e., a pulvinate *Sphæria* sessile on and inseparable from the subrepand cup; which does not seem to apply to the present species.

On thin bark of dead limbs, Castillo Viejo. (C. L. S.)

DALDINIA CONCENTRICA (*Bolt.*) *Ces. & De Not.*

On dead trees, Ometépe and Castillo Viejo. (C. L. S.)

USTILINA VULGARIS *Tul.*

Castillo Viejo. (C. L. S.)

CAMILLEA TURBINATA (*Berk.*) *E. & E.*
(HYPOXYLON TURBINATUM *Berk.*)

Varnished, erumpent, coffee-colored then black, at length entirely free; receptacle turbinate, attenuated downwards, with convex apex, in the center slightly depressed over the oblong, membranaceous perithecia. Asci ellipsoidal, short pedicellate, paraphysate. Sporidia oblong, $12–14 \times 8–10 \mu$, slightly laterally compressed, pale sooty.

On wood and fallen tree trunks near Apiahy, Brazil. Stromata 7–14 mm. high, 8–14 mm. wide, within at base white-flocculose, in the middle part compact, chestnut brown and sub-fibrous, and bearing the perithecia above. [Sacc. Syll. I, p. 372.]

The specimens collected at Castillo Viejo by myself, are almost sessile. Mr. Shimek collected specimens of this species at Ometépe, on bark, which are like the specimens from Castillo Viejo and some on wood which are on branching stipes.

C. BILABIATA *Speg.* *F. Puigg*, No. 259.

Superficial, black, rather small, sub-conical, 4–5 mm. wide, 2½–3 mm. high, deeply excavated at apex; the pit with obtuse margin, navicular-bilabiate. Perithecia cylindrical, wholly immersed in the stroma, 1½–2 mm. high, 0.2–.3 mm. dia. Asci and sporidia not seen.

On fallen, decaying branches in the woods near Apiahy, Brazil. [Sacc. Syll. IX, p. 541.]

The Nicaraguan specimens were without fruit, as were

Spegazzini's Brazilian specimens. On decaying tree trunk, Castillo Viejo. (C. L. S.)

XYLARIA OLOBAPHA *Berk.*

Growing on small, fallen, dead trees, Castillo Viejo. (C. L. S.)

X. TITAN *B. & C.*

On dead tree, Ometépe. (B. S. & C. L. S.) Some immature specimens which I collected at Castillo Viejo were thought to belong to this species.

X. OBOVATA *Berk.* Cuban Fungi, No. 785.

Gregarious, sessile or with a short, thick, smooth stipe 2–10 mm. long, globose or ovate, smooth, 10–13×13–20 mm., about the color of dark, weather-beaten wood, covered with a thin, separable crust, texture of the inside of the stroma spongy-fibrous, pale rose-color. Perithecia peripherical, buried in the stroma just under the crust, monostichous, ovate, about ¾–1 mm.; ostiola punctiform, minute. Asci (p. sp.) cylindrical, 100–110×6 μ, with a slender stipe, paraphysate, 8-spored. Sporidia uniseriate, oblong-navicular, obtuse, opake, 20–23 × 5–6 μ.

The stroma finally becomes more or less hollow by the shrinking and decay of the inner substance and the perithecia then adhere to the inner surface of the thin, enclosing crust. The Nicaragua specimens agree perfectly with Wright's Cuban specimens.

On the bark of a live tree near the ground, Castillo Viejo. (C. L. S.)

X. SCHWEINITZII *B. & C.*

Capitulum elliptical, obtuse, corky, compact, sparsely rimose, with an elongate, discrete, very smooth, varnished stipe. Perithecia globose; ostiola scattered and scarcely prominent. Sporidia cymbiform, 30 μ long.

On decaying wood, Surinam and Ceylon. The Ceylon specimens had shorter stipes than the Surinam specimens. A

species rather closely related to *X. polymorpha.* [Sacc. Syll. I, p. 323.]

The Nicaraguan specimens do not have a varnished stipe. Camp Menocal (about 15 miles from Greytown.) (B. S. & C. L. S.)

X. GUYANIENSIS *Mont.*

Simple. Club-clavate-cylindrical, brown, solid, white inside, about 2½ cm. long and ½–¾ cm. thick, smooth, obtuse and rounded at the apex, gradually narrowed below into the concolorous, smooth, stout stipe nearly as long as the fertile head. Perithecia large (1 mm.); sub-globose, peripherical, entirely buried, ostiola erumpent, papilliform, situated in the center of a depressed, dark-colored, circular disk ½–¾ mm. across. Asci slender, $150 \times 5–6\mu$, p. sp. $80–90\mu$ long, with abundant paraphyses. Sporidia 8 in an ascus, uniseriate, oblong-fusoid, slightly curved, dark, obtuse, $15–20 \times 3–4\mu$.

The ostiola at first raise the cuticle into a distinct papilla which falls off with a circumscissile dehiscence, leaving the circular disk aforesaid.

On dead wood, Ometépe. (B. S.) Castillo Viejo. (C. L S.)

X. PUMILA (*Fr.*) *Sacc.*

Sphæria pumila Fr., in Linnæa, 1830, p. 538. *Xylaria pumila*, Sacc. Syll. I, p. 313.

Small, ½–2 cm. high (including the short, 1–2 mm. stipe), 3–4 mm. thick; obtuse at the apex, black and colliculose-roughened from the large (1–1¼ μ), prominent, sub-globose, perithecia. Asci clavate-cylindrical, $150 \times 8–9\mu$, p. sp. $80–90\mu$ long, paraphysate, 8-spored. Sporidia uniseriate, oblong-fusoid, slightly curved or inequilateral, dark, $18–25 \times 6–7\mu$. Stroma dull white or rufous inside, dull black and granulose-squamulose outside. The specimens agree perfectly with South American specimens from Mr. Gaillard, but they are not glabrous as in the original diagnosis, though they may become so with age.

On bark of decaying tree, Castillo Viejo. (C. L. S.)

X. CORNIFORMIS *Fr.*

On fallen tree, Ometépe (B. S.); and Castillo Viejo (C. L. S). The specimens from Castillo Viejo were mostly immature.

X. HYPOXYLON (*Linn.*) *Grev.*

On dead trees, Ometépe (B. S.); and Castillo Viejo (C. L. S).

X. RHYTIDOPHLŒA *Mont.*

Simple. Stroma indurate, horny, compressed-terete, obtuse or horn-shaped, black, opake, very finely rugulose-reticulate, sooty within and very short stiped. Perithecia peripherical, globose, immersed, black stuffed, with slightly prominent ostiolum. Asci as in the genus. Sporidia very small, oblong-ovoid, fuscous.

On denuded wood Cayenne (Leprieur), Melbourne, Australia (Mueller). [Sacc. Syll. I, p. 319.]

On dead tree, Castillo Viejo. (C. L. S.)

X. CYLINDRICA *E. & E.* n. sp.

Simple, erect, small (1½ cm. high), stipitate, dark-brown. Head cylindrical, white inside, smooth except for the slightly prominent papilliform ostiola, about 8 mm. long and 2 mm. thick, abruptly narrowed at the apex into a short (1 mm. or less), erect, mucronate tip. Stipe erect, straight, slender, hirsute-tomentose (becoming sub-glabrous), about as long as the head. Perithecia buried, sub-globose, about ½ mm. dia. Sporidia uniseriate, navicular-oblong, brown, often 2-nucleate, sub-obtuse, $8\text{–}11 \times 3\frac{1}{2}\text{–}4\,\mu$.

Smaller than *X. mucronata* Sch., with different sporidia. The buried perithecia and even surface of the stroma will distinguish this from *X. hypoxylon*.

On bark, Ometépe; and Castillo Viejo (C. L. S).

ADDENDA.

NUMMULARIA GLYCYRRHIZA (*B. & C.*) *Sacc.*

The sporidia were elliptical, dark, 9–11×5–5½ μ.

On the bark of a rotten branch, Castillo Viejo. (C. L. S.)

HYPOXYLON HÆMATOSTROMA *Mont.*

Irregularly effused, confluent, convex, purplish-black. Perithecia peripherical, elongate-clavate, immersed and a little prominent, crowded in a blood-red stroma, stuffed within with a griseous-cellular nucleus, at length perforated by an apical pore. Sporidia navicular, hence gibbous.

On fallen bark, Cuba. [Sacc. Syll. I, p. 376.]

One specimen was collected on Ometépe The sporidia were 10–11×3½–4 μ. (C. L. S.)

ERRATA IN VOLUME II.

Page 113, for *Stemonitæ*, read *Stemonitaceæ*.
118, after Persoon, No. 7, read Plate I, Figs. 6 and 6*a*.
127, in line 26, for rough, read smooth.
137, in line 8, for delitely, read delicately.
144, for *lencopoda*, read *leucopoda*.
144, for 42, read 42*a*.
156, for 58, read 58*a*.

EXPLANATION OF PLATE I.

Fig. 1. Photomicrograph of section of embryo kitten about five millimeters in length.

Fig. 2. Photomicrograph of cephalic extremity of same section enlarged.

N. Nest of mesoblastic cells.
S. P. Seesel's pocket.
H. C. Hypophysis cerebri.
I. Infundibulum.
P. I. Processus infundibuli.
A. C. V. Anterior cerebral vesicle.
M. C. V. Middle cerebral vesicle.
P. C. V. Posterior cerebral vesicle.

PLATE I.

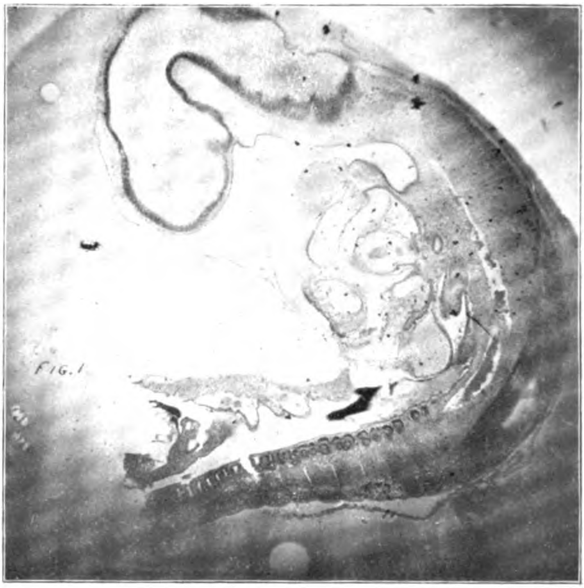


FIG. 1

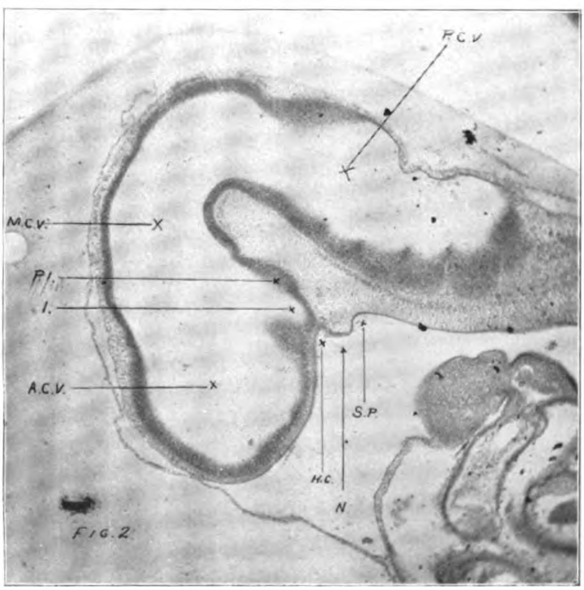


FIG. 2

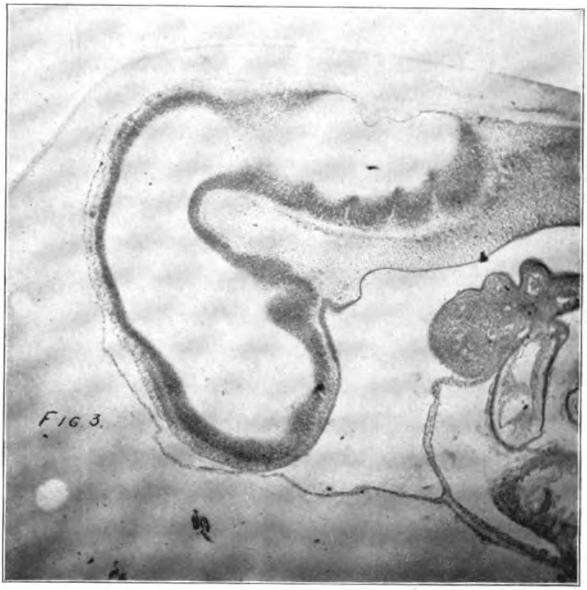
EXPLANATION OF PLATE II.

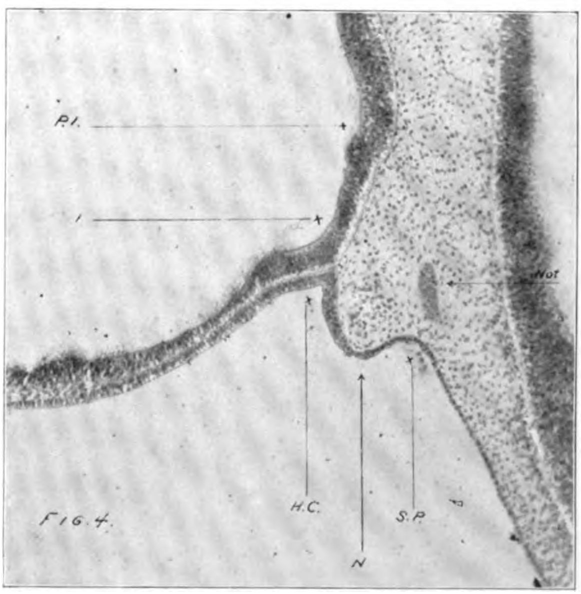
Fig. 3. Photomicrograph of cephalic extremity of another section of the five millimeter embryo from which Figures 1 and 2 were made.

Fig. 4. Photomicrograph of the region under consideration from still another section of the five millimeter embryo. This section is in the median plane.

N. Nest of mesoblastic cells.
S. P. Seesel's pocket.
H. C. Hypophysis cerebri.
I. Infundibulum.
P. I. Processus infundibuli.
Not. Notochord.

PLATE II.





EXPLANATION OF PLATE III.

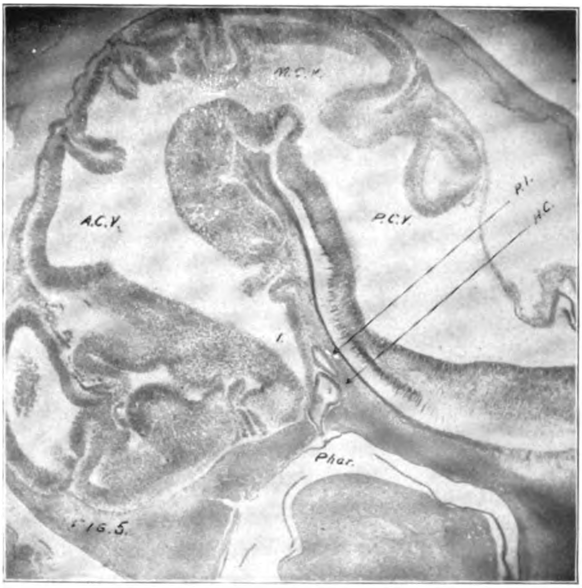
Fig. 5. Photomicrograph of section of cephalic extremity of embryo kitten about seventeen millimeters in length.

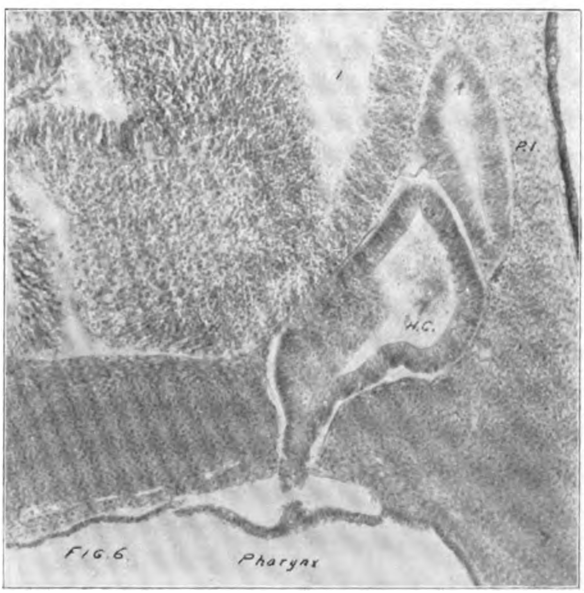
I. Infundibulum.
P. I. Processus infundibuli.
H. C. Hypophysis cerebri.
A. C. V. Anterior cerebral vesicle.
M. C. V. Middle cerebral vesicle.
P. C. V. Posterior cerebral vesicle.
Phar. Pharynx.

Fig. 6. Photomicrograph of the region under consideration, from the same section, enlarged.

I. Infundibulum.
P. I. Processus infundibuli.
H. C. Hypophysis cerebri.

PLATE III.





EXPLANATION OF PLATE IV.

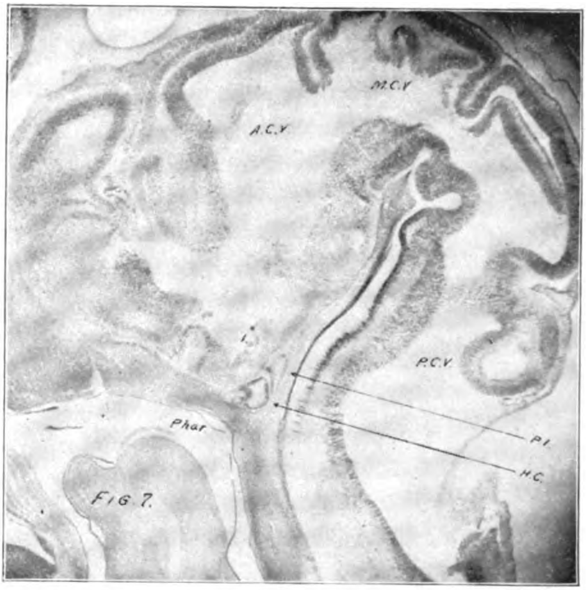
Fig. 7 Photomicrograph of section of cephalic extremity of embryo kitten about seventeen millimeters in length. Another section from same series as Figures 5 and 6.

P. I	Processus infundibuli.
H. C.	Hypophysis cerebri.
A. C. V.	Anterior cerebral vesicle.
M. C. V.	Middle cerebral vesicle.
P. C. V.	Posterior cerebral vesicle.
Phar.	Pharynx.

Fig. 8. Photomicrograph of the region under consideration, from the same section, enlarged.

P. I.	Processus infundibuli
H C.	Hypophysis cerebri.

PLATE IV.



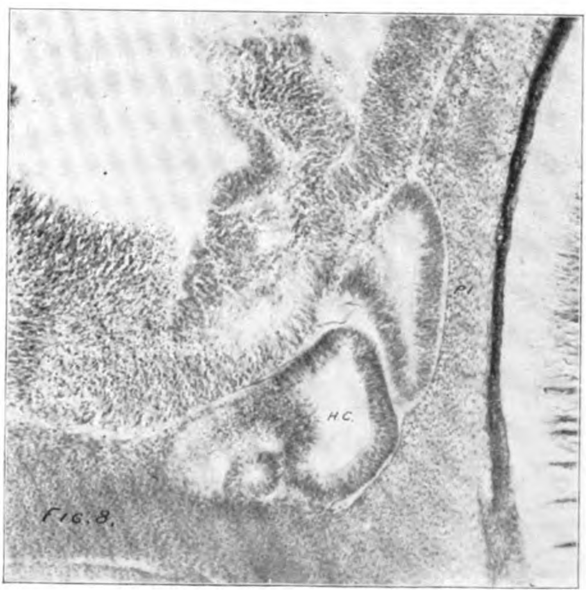


PLATE V.

FROM DRAWINGS BY H. F. WICKHAM.

Fig. 1. Patella of *Dytiscus fasciventris* Say.
Fig. 2. Patella of *Cybister fimbriolatus* Say.

PLATE V.

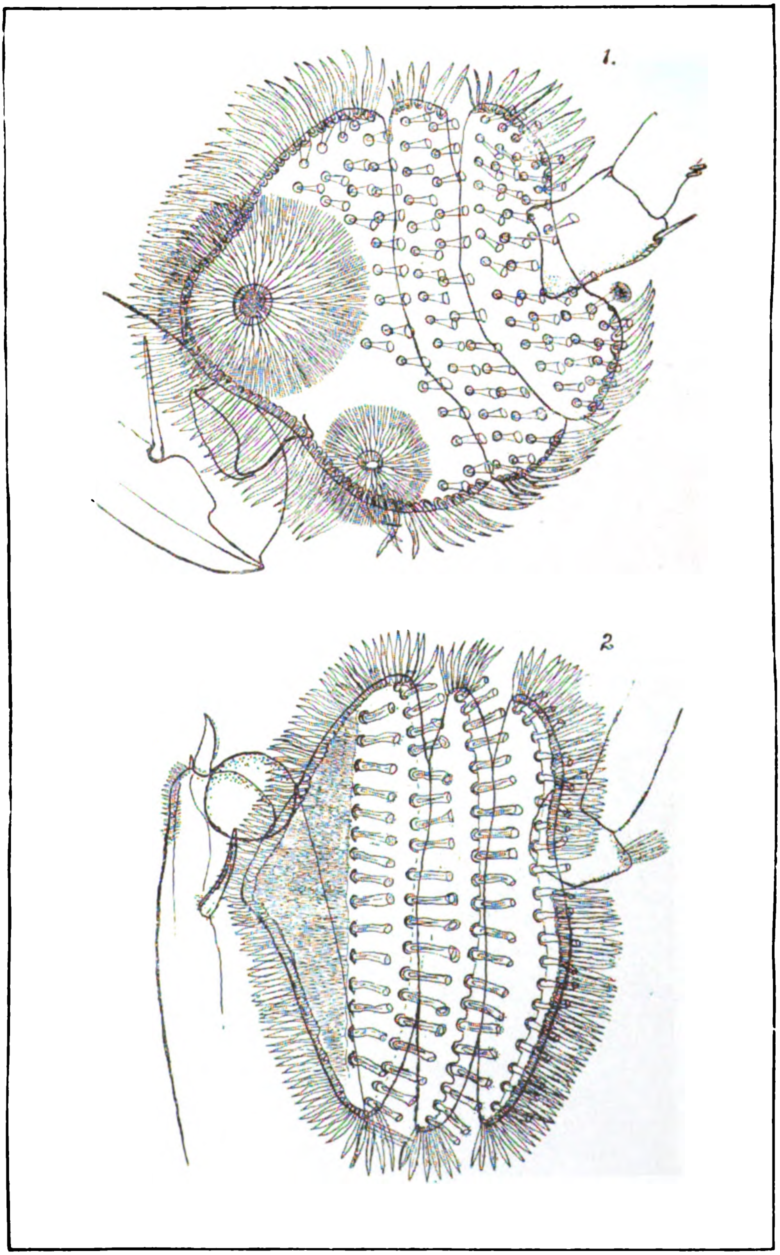


PLATE VI.

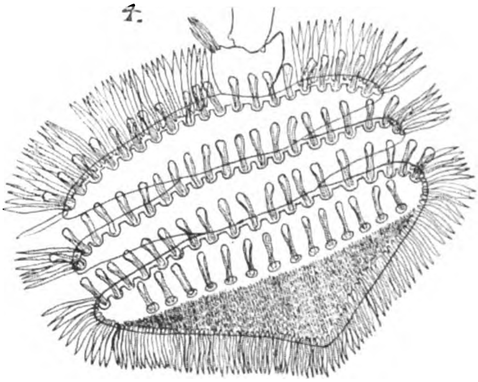
FROM DRAWINGS BY H. F. WICKHAM.

Fig. 3. Patella of *Dytiscus harrisii* Kirby, with small palettes removed, showing arrangement of the sexual hairs.

Fig. 4. Patella of *Cybister explanatus* Lec.

PLATE VI.

1.



3.

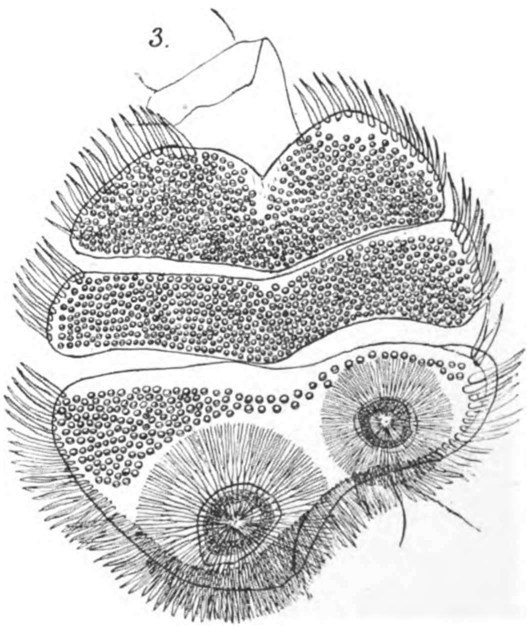


PLATE VII.

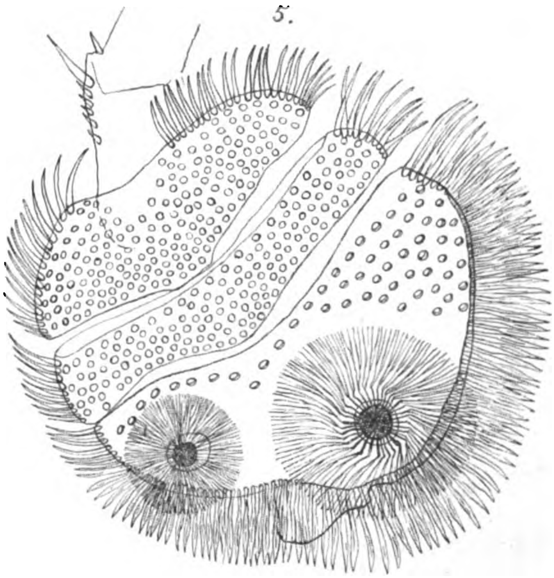
FROM DRAWINGS BY H. F. WICKHAM.

Fig. 5. **Patella of *Dytiscus circumcinctus* Ahr., with palettes removed as in Fig. 3.**

Fig. 6. **Patella of *Dytiscus marginalis* L., with small palettes removed.**

PLATE VII.

5.



6.

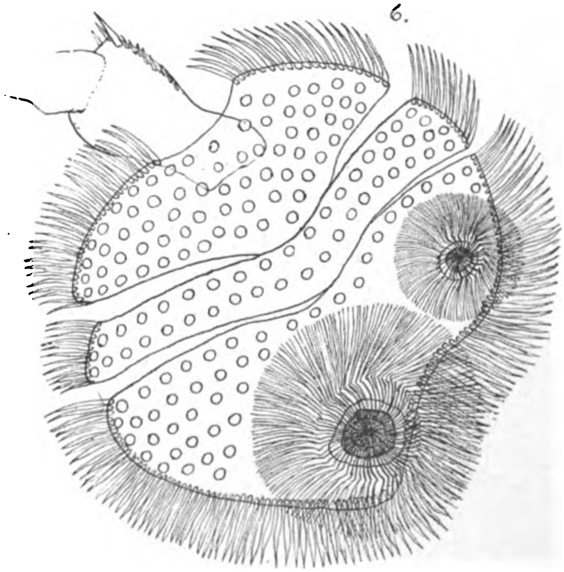


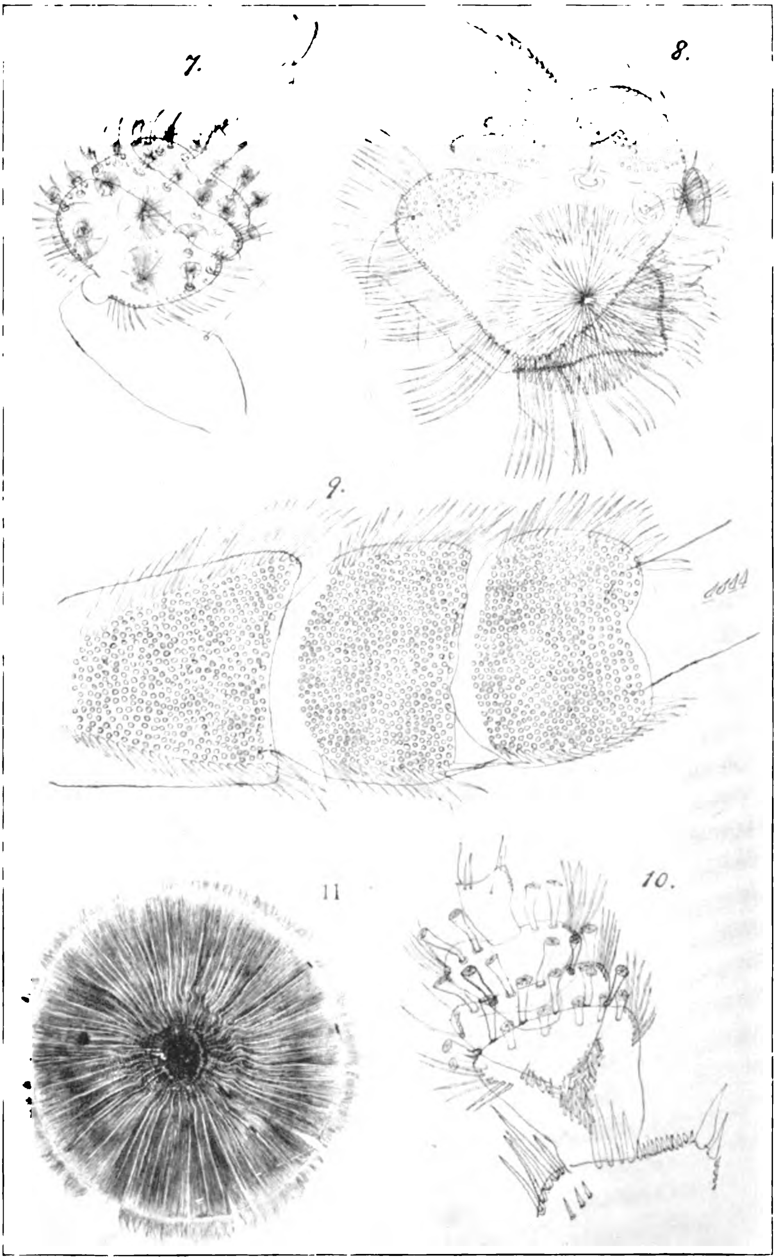
PLATE VIII.

FROM DRAWINGS BY H. F. WICKHAM.

FIG. 11. BY MISS MARY P. McBRIDE.

Fig. 7. Patella of *Thermonectes ornaticollis* var. *nigrofasciatus* Aube.
Fig. 8. Patella of *Acilius fasciatus* De Geer, with small palettes removed
Fig. 9. Middle tarsus of *Dytiscus harrisii* Kirby, with small palettes removed.
Fig. 10. Anterior tarsus of *Colymbetes sculptilis* Harr.
Fig. 11. Large palette of *Dytiscus marginalis* Linn.

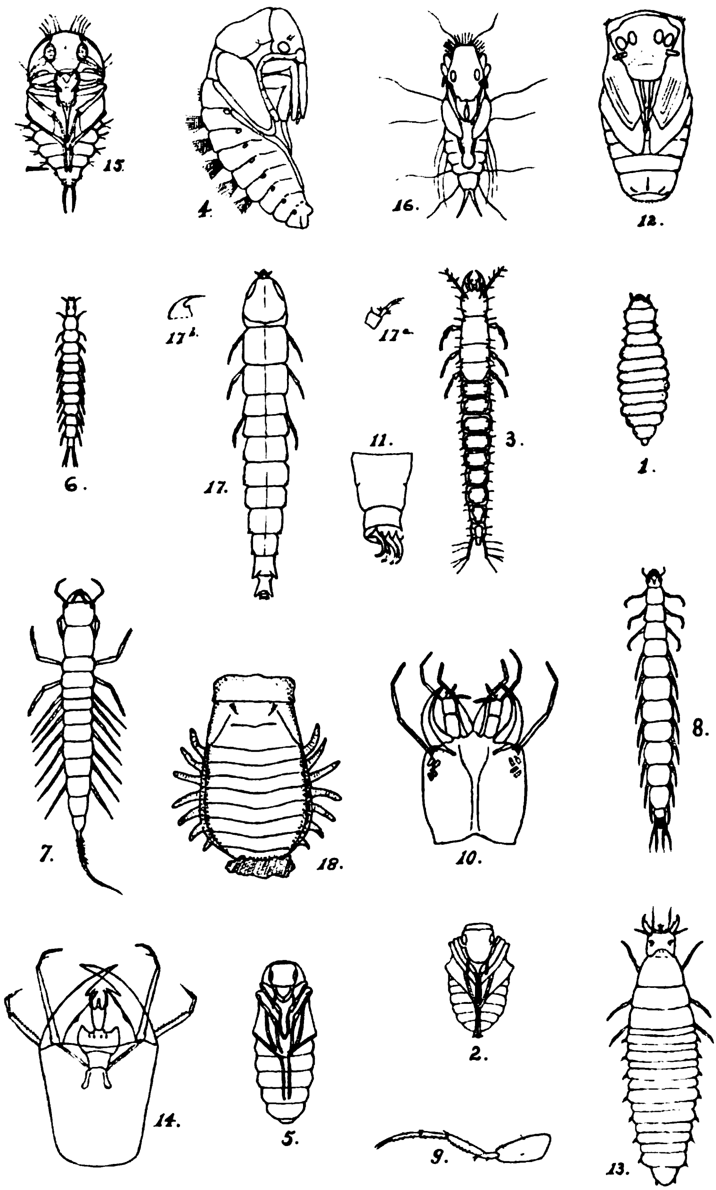
PLATE VIII.



EXPLANATION OF PLATE IX.

Fig. 1. *Brachinus janthinipennis* Dej., larva.
Fig. 2. *Brachinus janthinipennis* Dej., pupa.
Fig. 3. *Scarites subterraneus* Fabr., larva.
Fig. 4. *Scarites subterraneus* Fabr., pupa.
Fig. 5. *Pterostichus lucublandus* Say, pupa.
Fig. 6. *Gyrinus picipes* Aube, (?) larva.
Fig 7. Gyrinid (?) larva.
Fig. 8. *Dineutes assimilis* Aube, larva.
Fig. 9. *Dineutes assimilis* Aube, leg of larva.
Fig. 10. *Dineutes assimilis* Aube, head of larva.
Fig. 11. *Dineutes assimilis* Aube, anal segment of larva.
Fig. 12. *Dineutes assimilis*, Aube, pupa.
Fig 13. *Tropisternus glaber* Hbst., larva.
Fig 14. *Tropisternus glaber* Hbst., diagram of head from beneath.
Fig. 15. *Tropisternus glaber* Hbst., pupa.
Fig. 16. *Cryptobium bicolor* Grav., pupa.
Fig. 17. *Chauliognathus profundus* Lec., larva; *a*, antenna; *b*, mandible.
Fig. 18. *Aphorista morosa* Lec., pupa.

PLATE IX.



H. F. WICKHAM, DEL.

EXPLANATION OF PLATE X.

Physarum maculatum Macb., p. 383.

Fig. 1 Stipitate sporangia × about 14.
Fig. 1*a*. Capillitium of the same highly magnified.
Fig. 1*b*. Spore × 1000 (The *b* was by some chance omitted from the drawing.)

Physarum nicaraguense Macb., p. 382.

Fig. 2. Sporangia × about 14. The sporangia are all stipitate.
Fig. 2*a*. Capillitium, highly magnified.
Fig. 2*b*. A single spore × 1000.

Comatricha shimekiana. Macb., p. 380.

Fig. 3. Sporangia × about 10.
Fig. 3*a*. Capillitium × 30. The stipe breaks directly into the larger branches.
Fig. 3*b*. A single spore × 1000.

Stemonitis smithii Macb., p. 381.

Fig. 4. Sporangia × 4.
Fig. 4*a*. Capillitium × about 30.
Fig. 4*b*. Spore × 1000.

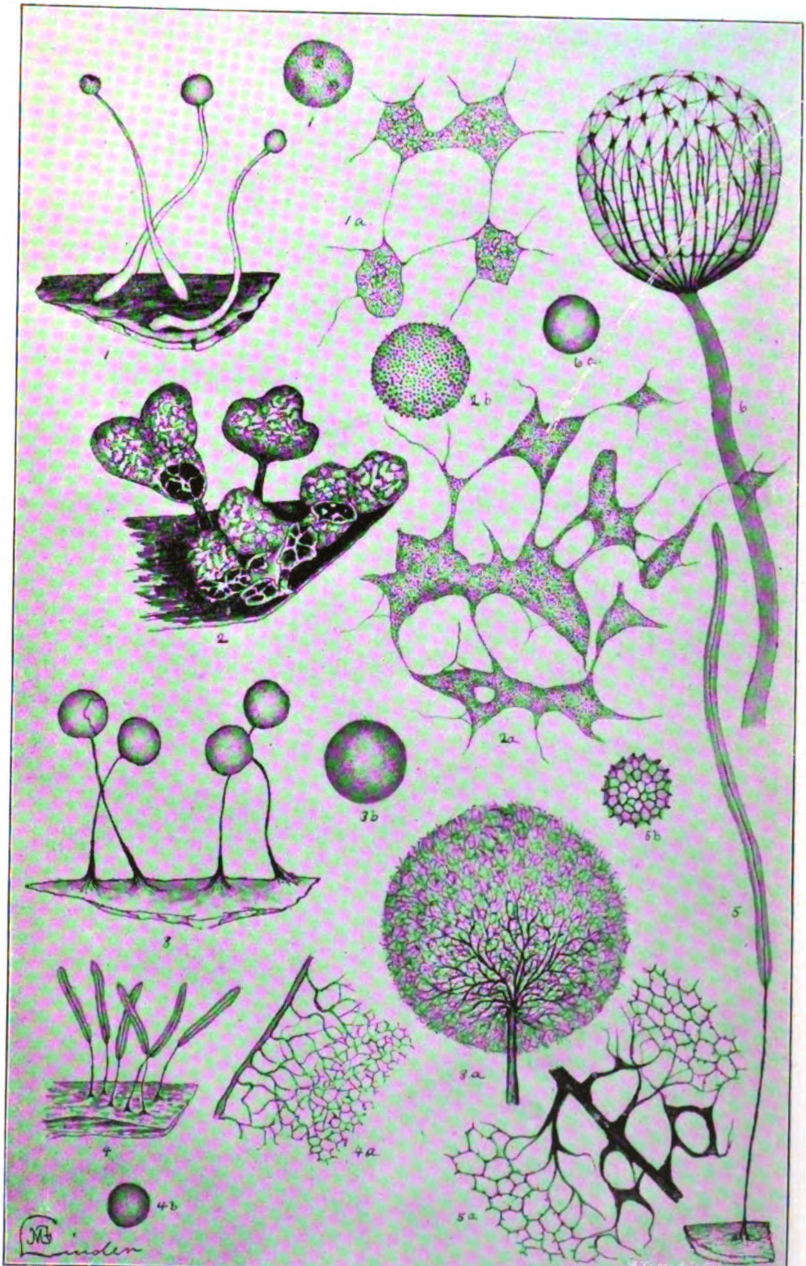
Stemonitis castillensis Macb., p. 381.

Fig. 5. Sporangium × about 6.
Fig. 5*a*. Capillitium × about 40.
Fig. 5*b*. A single spore × 1000.

Cribraria exilis Macb., p. 378.

Fig. 6. The sporangium × 50. The drawing rather diagrammatic.
Fig. 6*a*. A single spore × 1000.

PLATE X.



EXPLANATION OF PLATE XI.

Physarum newtoni Macb., p 390.

Fig. 1. Sporangia × 20.
Fig. 1*a* Capillitium highly magnified.
Fig. 1*b*. Spore × 1000.

Physarum columbinum Macb., p. 384.

Fig. 2. Sporangia × about 20.
Fig. 2*a*. Capillitium highly magnified.
Fig. 2*b*. Single spore × 1000.

Physarum oblatum Macb., p. 384.

Fig. 3. Sporangia × 24.
Fig. 3*a*. Capillitium highly magnified.
Fig. 3*b*. A single spore × 1000.

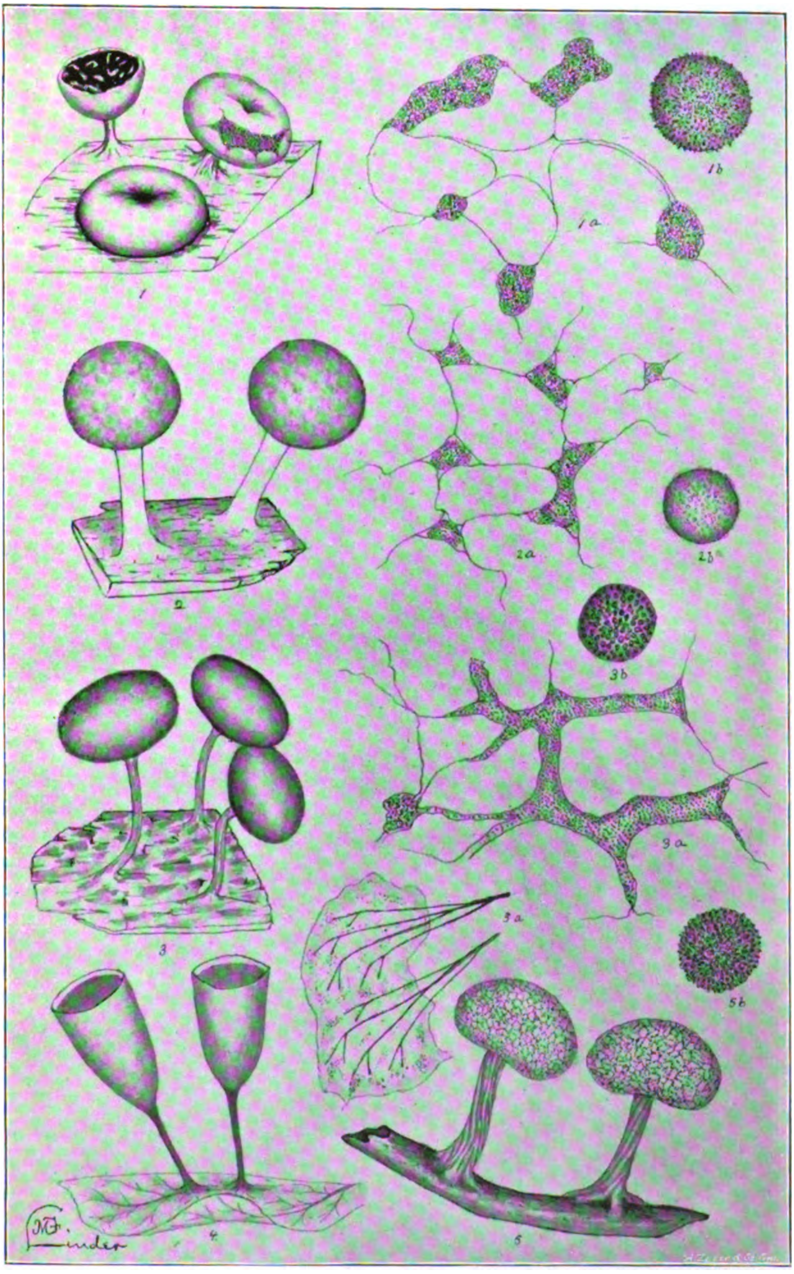
Craterium pedunculatum Trent., p. 385.

Fig. 4. Sporangia 14.

Didymium squamulosum (A. & S.) Fries, p. 386

Fig. 5. Sporangia × 14.
Fig. 5*a*. Tips of capillitial threads adhering to the inner surface of the peridial wall.
Fig. 5*b*. A single spore × 1000.

PLATE XI.



EXPLANATION OF PLATE XII.

Bennettites dacotensis Macb.

Fig. 1. Lateral view of a good specimen × ¼.

Fig. 2. Surface view of an abraded specimen; shows the leaf-bases in section and in the section the distribution of the fibro-vascular bundles.

PLATE XII.

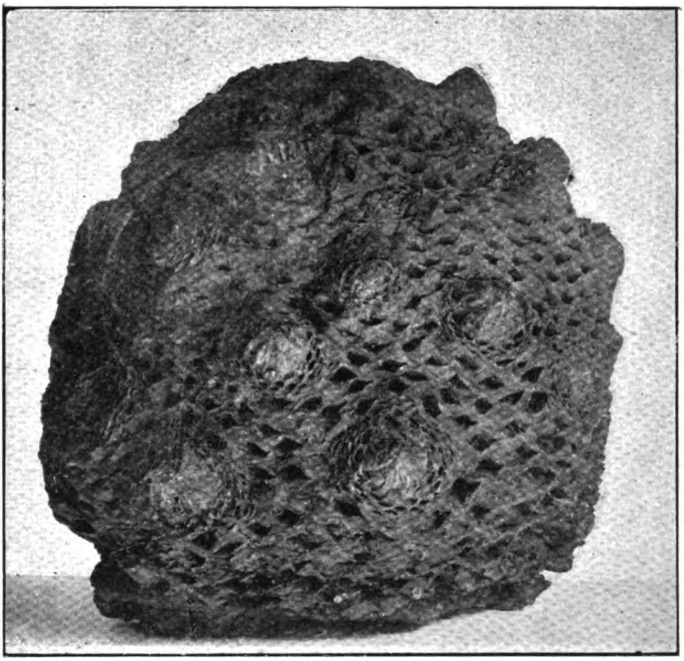


FIG. 1.

FIG. 2.

BENNETTITES DACOTENSIS Macbride.

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